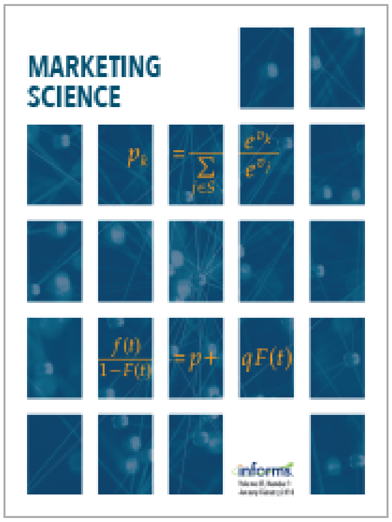

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Risk Behavior in Response to Quotas and Contests

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Abstract

Much of the salesforce compensation literature has focused on developing incentive schemes to maximize effort levels on the part of the salesforce. The amount of effort to expend in the selling task is considered to be the sole decision variable for a sales representative. In this paper, we introduce another key decision variable for a sales representative which is how much risk to undertake in the selling task. In other words, we consider the fact that for a sales representative "riskiness" of performance (e.g., the dispersion of the probability distribution for sales) is often a choice and not a given fate. For example, a sales representative, trying to increase sales, may have the choice of allocating a given amount of effort on the low-risk approach of pursuing a small set of existing customers or incur the same effort on the high-risk option of getting new larger customers to switch from competitors.

This paper examines how decisions on risk behavior on the part of the sales representatives are influenced by compensation schemes. We show that such decisions are sensitive to the payoff structure when a quota-based or a rank-order contest-based compensation scheme is used. More specifically, we argue that a high quota level or a rank-order contest where only the top few win induce sales representatives to opt for high-risk prospects, whereas a low quota level or a rank-order contest where a high proportion win induce sales representatives to opt for low-risk prospects. This does not stem from any kind of violation of standard expected utility theory but arises from the specific structure of jumps in payoffs. It is not that the inherent risk attitudes of the sales representatives are being altered. Rather, under some quota and contest conditions, a more risky prospect may yield higher expected utility for an inherently risk-averse sales representative while under some other quota and contest conditions, a less risky prospect may lead to a higher expected utility for an inherently risk-seeking sales representative.

The theoretical propositions are tested in a series of five experiments. The first two experiments test the theoretical results of quota-based compensation. The quota levels are manipulated. Subjects select between segment types where the mean expected sales are the same but the variance varies. The next two experiments test the risk behavior of subjects in contest-based incentive schemes when the proportion of winners in the contest is manipulated. The results provide strong support for our models, with only a few subjects departing from the theoretical predictions. A fifth experiment shows some cognitive response data to explain the behavior that is inconsistent with the theoretical predictions.

This paper provides implications that are useful for managers who design compensation schemes. A common assumption in most normative models on salesforce compensation is that all sales representatives are either risk averse or risk neutral. This might often lead to the conclusion that sales representatives cannot be expected to engage in high-risk activities in the absence of a risk premium over and above the compensation scheme. While this may be true if sales representatives are facing only a piece-rate compensation plan, it need not be the case when quota-based or contest-based compensation schemes are used. Our results suggest that when the sales quotas are set "high" or if the proportion of winners in a sales contest is "low", sales representatives may engage in high-risk behavior. Alternatively, if the quotas are "low" or the proportion of winners in a sales contest is "high", sales representatives may engage in low-risk prospects. Hence, if a firm would like to dampen high-risk behavior on the part of the salesforce, lowering quota levels or increasing the proportion of winners in sales contests might do so. Similarly, in order to reduce conservatism towards risk, moving up the quota levels or reducing the proportion of winners in sales contests could be useful.

Our results extend beyond just salesforce management, to any situation where payoffs are based on reaching a certain threshold level in performance or are based on relative performance. For example, similar implications hold in tournaments for promotion to a limited number of top management positions in an organization, influencing the portfolio of R&D managers, and so on.

(*Quotas*; *Risk Taking*; *Sales Contests*; *Salesforce Compensation*)

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1. Introduction

Salesforce compensation is a crucial issue in management and, not surprisingly, has received much attention in the marketing literature. The commonly used compensation schemes are piece-rate (salary as a direct function of sales output), quota-based (a fixed salary and a flat bonus or a piece-rate commission beyond a certain level of sales), and sales contests (a fixed salary and a bonus if the sales are among the top few). Much of the focus in marketing research has been on designing optimal compensation schemes, driven primarily by an agency theory perspective (see, for example, Basu et al. 1985; Lal and Staelin 1986; Raju and Srinivasan 1994). The problem is formulated as one of optimization of the firm's profit, taking into account the likely behavior of the sales representatives in response to the various compensation schemes. Such analysis, however, is limited to piece-rate and quota-based schemes. Research on rank-order contests in the marketing literature has been mainly in the form of surveys substantiating their widespread use. Chrapek (1989), for example, reports that the expenditure on sales contests increased from $1.6 billion in 1971 to over $8 billion in the 1980s, and that 83% of the firms in a survey reported usage of contests in some form. Theoretical models of contests have been widely analyzed in the economics literature (see, for example, Lazear and Rosen 1981; O'Keeffe et al. 1984), and Frank and Cook (1995) in their recent book provide evidence for the ubiquity of contests in all aspects of real life.

In contrast to piece-rate compensation, quota-based and contest-based compensation schemes are often considered conceptually similar. While in contests sales representatives compete against each other, quotas are also viewed as a type of contest where employees compete with themselves (Churchill et al. 1993). Quotas and contests are extensively used as short-term incentive programs (*Sales and Marketing Management* 1989). Also, several different formats are observed. Churchill et al. (1993) report that 35% of the quotas and contests are designed such that sales representatives have 1 in 5 odds of succeeding, 31% are designed with odds of success at about 2 in 5, 21% have odds of 3 in 5, and 13% have odds of 4 in 5.

Almost all the analysis on salesforce compensation schemes (e.g., Basu et al. 1985) and on contests (e.g., Lazear and Rosen 1981) focuses on the problem of inducing greater effort on part of the participants. Effort is assumed to be the key decision variable for a participant, and the participant's given ability is considered as a critical parameter for his/her success. Greater effort increases the chances of success for a participant, as does higher ability. Of course, at a given level of ability and effort, random fluctuations do occur in the participant's performance. However, it is assumed that the random fluctuations are part of exogenous noise over which the participant has no control. For example, in a typical model, a sales representative (contestant) might be able to shift the probability distribution of sales (output) to a higher mean by expending greater effort but the dispersion of the distribution is considered as a given. Furthermore, it is common to assume that most sales representatives are risk averse (see, for example, Coughlan and Sen 1989) and hence cannot be expected to perform risky sales activities. Such risk-aversion on the part of the sales representatives implies preference for the less risky (for example, lower variance with the same expected value) option.

In this paper, we introduce another key decision variable for a sales representative, which is how much risk to undertake in the selling task with a given level of effort. In other words, we consider the fact that for a sales representative "riskiness" of performance (e.g., the dispersion of the probability distribution for sales) is often a choice and not a given fate. Consider, for example, a sales representative who, at a given level of effort, has the option of pursuing two different customers: one whose order will be worth $250,000 with the probability of obtaining the order at 0.8 and another whose order will be worth $1 million with the probability of success at 0.2. Both options have the same expected value, but the second option is presumably more risky. Under a piece-rate compensation scheme, where a sales representative faces a continuous payoff function, it is obvious that a risk-averse sales representative will always opt for the less risky option. However, this is not necessarily the case when quota-based or contest-based compensation schemes are used and this is precisely what we show in this paper.

We develop a parsimonious model and provide empirical evidence from laboratory experiments to show that the risk behavior of sales representatives is affected by the payoff structure of quota-based and contest-based compensation schemes independent of the shape of their utility functions. So, it is possible that a risk-averse sales representative will opt for a higher-risk option even in the absence of any special risk premium over and above the regular compensation. Similarly, a risk-seeking individual (one with a convex utility function) might choose a less risky option when facing some of the commonly used quota-based and contest-based compensation schemes. More specifically, we argue that a high quota level or a rank-order contest where only the top few win induce sales representatives to opt for high-risk prospects, whereas a low quota level or a rank-order contest where a high proportion win induce sales representatives to opt for low-risk prospects. This does not stem from any kind of violation of standard expected utility theory, as it has been noted in some studies (see, for example, Ross 1991), but arises from the specific structure of the payoffs (the jumps in the payoffs). Of course, it is not the inherent risk attitudes of the sales representatives which are being altered. Rather, under some quota and contest conditions, a more risky prospect may yield higher expected utility for an inherently risk-averse manager and, under some other quota and contest conditions, a less risky prospect may lead to a higher expected utility for an inherently risk-seeking manager. From a firm's point of view, this provides the insight that by altering the quota levels or proportion of winners in a contest a firm can affect the risk in performance taken by its employees.

The results in this paper are also applicable in contexts other than just salesforce compensation. For example, product managers have to often choose between innovative but high-risk R&D projects and projects that yield safe but incremental improvements, a brand manager can engage in a risky advertising campaign or in a safe positioning, mutual fund managers can choose the volatility of their portfolios, and so on.

The remainder of this paper is organized as follows. In §2, we outline the characterization of comparative risk. In §3, we consider the choice of risk for a sales representative under a quota-based compensation scheme, and in §4 we present similar results for rank-order contests. The experimental studies are discussed in §5. Section 6 concludes the paper and discusses some managerial implications of the results.

2. Comparative Risk

Before we begin to discuss the choice of riskiness in performance on the part of a sales representative, we must clearly define what we mean by a more risky or a less risky prospect for a sales representative. Suppose that a sales representative, for her performance level, has a choice between two uncertain prospects (i.e., two probability distributions) with the same expected value but a higher variance in one case. It is then common to assume that the prospect with the higher variance is more risky. However, comparison of uncertain prospects by a mean-variance analysis is often considered inadequate. As Rothschild and Stiglitz (1970, p. 241) state,

> The method most frequently used for comparing uncertain prospects has been mean-variance analysis. It is easy to show that such comparisons may lead to unjustified conclusions. For instance, if X and Y have the same mean, X may have a lower variance and yet Y will be preferred to X by some risk-averse individuals.

They proceed to show that for any nonquadratic concave utility function, there exist rankings of uncertain prospects by expected utility and by variance that are different. On the other hand, consider two cumulative distribution functions (c.d.f.s) G and F with the same finite mean such that all risk-averse (those with concave utility functions) expected utility maximizers prefer F to G. Then it would be reasonable to say that G is more risky than F. Rothschild and Stiglitz (1970) provide such a characterization of comparative risk in terms of a *mean preserving spread,* defined below.

Definition 1.[1] A c.d.f. G differs from a c.d.f. F by a *mean preserving spread* (MPS) if there exists an interval I such that G assigns no greater probability than F to any open subinterval of I and G assigns at least as

[1]This more general definition, which does not require a distinction between the absolutely continuous and the discrete case, can be found in Landsberger and Meilijson (1990) and Pratt and Machina (1997).

much probability as F to any open interval either to the left or to the right of I.

Rothschild and Stiglitz (see also Landsberger and Meilijson 1990; Pratt and Machina 1997) link an MPS to the idea of an increase in risk by demonstrating that the following four conditions for a pair of univariate c.d.f.s. G and F, with the same finite mean, are equivalent: (a) G can be obtained from F by a sequence of one or more *mean preserving spreads,* where informally speaking, an MPS is an operation which moves probability mass in a distribution from some central region to the tail regions; (b) G can be obtained from F by the addition of *noise;* (c) G is *second-order stochastically dominated* by F, where G and F have the same mean; and (d) every risk-averse expected utility maximizer prefers F to G; that is,

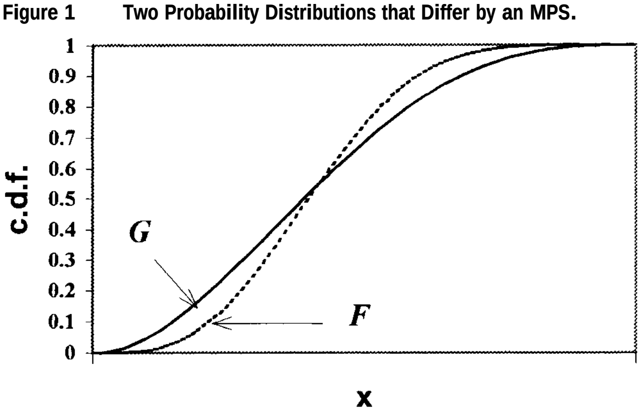
$$\int U(x)dF(x) \geq \int U(x)dG(x)$$

for every (not necessarily increasing) concave function U.

In the case above, we say that G is more risky than F. Figure 1 shows two distributions G and F which differ by an MPS. If G and F differ by an MPS then G and F have a single crossing, i.e., there exists some outcome level c such that $G(x) \geq F(x)$ for $x < c$ and $G(x) \leq F(x)$ for $x \geq c$.[2] It is clear from the figure that G has more probability mass nearer to the tails relative to F and, if G and F have the same mean, then G must have higher variance than F.[3]

[2]Even if G and F cross only once, the value of x at which they cross need not be unique. Also, a mean preserving single crossing does not necessarily imply an MPS (Pratt and Machina 1997).

Figure 1 Two Probability Distributions that Differ by an MPS.



The Rothschild-Stiglitz characterization of comparative risk remains dominant in the standard economics and finance literature (Scarsini 1994). In this paper, we use the definition of Rothschild-Stiglitz MPS to characterize comparative risk—however, with an additional specification. The point of single crossing between G and F (which differs by an MPS) plays an important role in the analysis in the paper. Accordingly, the following definition is adopted.

Definition 2. G is said to differ from F by a *mean preserving spread about c* (MPS about c), and F is said to differ from G by a *mean preserving contraction about c* (MPC about c), if G differs from F by an MPS and c is a point of crossing between G and F.[4]

Consider, for example, a mean preserving increase (decrease) in variance for a symmetric distribution. The increase (decrease) in variance implies an MPS (MPC) about the mean. The class of MPS about c forms a proper subset of the class of MPS.

3. Quota-Based Compensation

Consider a sales representative who gets a fixed salary A and a bonus B if her sales equal or exceed a certain level q. Of course, A, B, and q are assumed to be strictly positive. Suppose that the sales representative has a choice between two c.d.f.s, F and G, for her dollar (or unit) sales with no associated costs. Let the corresponding probability density function (p.d.f.) of F be uniform on [10, 20] and that of G be uniform on [0, 30]. Clearly, G differs from F by an MPS about the mean and, hence, we can say that G is more risky than F. First, consider $q = 17$. If the sales representative opts for F, her probability of getting the bonus is $(20-17)/(20-10) = 0.3$, whereas her probability of obtaining the bonus with G is $(30-17)/(30-0) = 0.43$. Next, consider

[3]Ordering of distributions using the concept of MPS is only partial, while the ordering by a mean-variance analysis is complete.

[4]Recall that the value of c need not be unique (see Footnote 2). The term "mean preserving spread about ν," is also used in Landsberger and Meilijson (1990). Their definition, however, does not necessarily imply a crossing at ν.

$q = 13$. Now, the sales representative's probability of getting the bonus is 0.7 with F and 0.57 with G.

Assuming that the sales representative is an expected utility maximizer with a nondecreasing utility of the payoff, it appears that the sales representative is better off increasing risk in the first case, and choosing lower risk in the second case. It is easy to verify that higher risk is strictly preferable as long as $q > 15$ (the mean of F and G), and lower risk is strictly preferable if $q < 15$. This seems reasonable since the sales representative will choose the option that maximizes her chances of getting the bonus and hence expected utility. Intuitively, when the quota is high, the greater volatility of sales increases the upside potential by increasing the chances of exceeding the set quota, and the greater downside risk is inconsequential since the payoff is bounded from below by the fixed salary. On the other hand, when the quota is low, a more risky sales distribution appears to lower the probability of obtaining the bonus. We discuss this phenomenon below in a more general form for all distributions.

Proposition 1. *Let a random variable X, $X \geq 0$, be the dollar sales of a sales representative whose compensation plan is given by*

$$S(x) = \begin{cases} A & \text{if } x < q, \\ A + B & \text{if } x \geq q, \end{cases}$$

with $A > 0$, $B > 0$, and $q > 0$. Let G and F be two c.d.f.s (absolutely continuous or discrete) such that G is more risky than F in the sense that G differs from F by an MPS about c. Suppose that the sales representative can choose G or F as a distribution for X. Then, given that the sales representative is an expected utility maximizer with a nondecreasing utility function U(S(x)), she will (weakly) prefer G to F if and only if the quota is "high," i.e., $q > c$.

Proof. See the Appendix.

The preferences in Proposition 1 will be strict preferences if and only if G and F are not identical. Consider, for example, a mean preserving increase (decrease) in variance in a symmetric distribution, which would be an MPS (MPC) about the mean. The increase (decrease) in variance will be strictly preferred if and only if the quota is above (below) the mean. Also, in general, for a higher q the class of acceptable MPSs is larger since the interval of values for c which satisfy $q > c$ is larger. In other words, the set of increases in risk that would be acceptable to a sales representative (independent of her inherent risk attitude) would be larger for a higher level of sales quota.

Effort

In this paper, for reasons of expositional development and space, we consider riskiness of performance as the sole decision variable for a sales representative. Of course, how much effort to expend in the selling task is also a decision variable available to a sales representative. For example, within the context of Proposition 1, consider $Y = z_e + X$ as the total dollar sales of a sales representative, where z_e is a deterministic sales level based on effort e, and X is a nonnegative random variable. The sales representative, facing a quota level q, can choose distribution d (where d is G or F) for X and can also decide on the level of effort e. Further, let the utility function of the sales representative be of the form

$$U(S(y),e) = U_1(S(y)) - U_2(e),$$

where U_1 and U_2 are nondecreasing functions in their arguments. We can think of U_1 as the utility of monetary payoffs and U_2 as the "disutility" of effort. Then, the expected utility for a sales representative with distribution d and effort e is

$$\begin{aligned} EU(S(y), e) &= P_d[X \geq q - z_e]U_1(A + B) \\ &\quad + (1 - P_d[X \geq q - z_e])U_1(A) - U_2(e) \\ &= U_1(A) + P_d[X \geq q - z_e] \\ &\quad [U_1(A + B) - U_1(A)] - U_2(e). \end{aligned}$$

The sales representative will choose $d = d^*$ and $e = e^*$ such that

$$\begin{aligned} \max_{d,e} \{P_d[X \geq q - z_e][U_1(A + B) - U_1(A)] \\ - U_2(e)\} = P_{d^*}[X \geq q - z_{e^*}][U_1(A + B) \\ - U_1(A)] - U_2(e^*). \end{aligned}$$

At a given level of effort, it follows from Proposition 1 that the sales representative will choose G over F if and only if $q > c + z_e$, i.e., higher levels of the quota are more likely to induce the sales representative to opt for greater riskiness in performance. However, it is also easy to construct examples where a sales representative will opt for G and a low level of effort over F and a high level of effort. In other words, a high level of quota may induce a sales representative to increase risk in performance while lowering the effort level at the same time. The tradeoff is between the disutility of effort and adopting greater risk in performance. As the disutility of effort increases, one would expect that a sales representative is more likely to attempt attaining the quota by adopting greater risk in performance rather than by expending greater effort. Further, the effort level that a sales representative can choose is likely to be bounded from above. After reaching that bound, engaging in high-risk behavior might be the only way for a sales representative to increase the probability of attaining a high quota. The point is that riskiness in performance remains a key decision variable for a sales representative and an important determinant of success.

Generalization of Proposition 1

In the next proposition, we show that a result similar to Proposition 1 holds for *all* possible variations of a quota-based compensation scheme used in real-life and for *all* distributions.

PROPOSITION 2. *Let a random variable X, $X \geq 0$, be the dollar sales of a sales representative whose compensation plan is given by*

$$S(x) = \begin{cases} A & \text{if } x < q, \\ A + \phi(x) & \text{if } x \geq q, \end{cases}$$

where $A > 0$, $q > 0$, and ϕ is nonnegative and nondecreasing in x. Let G and F be two c.d.f.s (absolutely continuous or discrete) such that G is more risky than F in the sense that G differs from F by an MPS about c. Suppose that the sales representative can choose G or F as a distribution for X. Assume that the sales representative is an expected utility maximizer who has a nondecreasing utility function $U(S(x))$ with a continuous first derivative. Then, if the quota is "high," i.e., if $q > c$, she will (weakly) prefer G to F.

PROOF. See the Appendix.

The necessary and sufficient condition in Proposition 1 for engaging in greater risk behavior is only a sufficient condition (in a minimal sense) in Proposition 2. The necessary condition here is simply that G should yield greater expected utility than F. In some cases of this more general setup, even if the quota is "low," i.e, $q \leq c$, G might be preferable to F. This seems reasonable since the bonus is not fixed but is larger for higher values of x beyond the quota. Thus the primary objective is not to just cross the quota but also to try and go as far beyond the quota as possible. Intuitively, this should increase the attractiveness of a more risky distribution vis-à-vis the case where the bonus is fixed for all values of x beyond the quota.

In the next section, we examine similar implications for a sales representative's risk behavior in rank-order contests.

4. Contest-Based Compensation

Consider 10 sales representatives who are involved in a rank-order contest. Any one sales representative gets a fixed salary A and a bonus B (A and B are strictly positive) if her sales are among the top 3 sales. Let the dollar sales of the 10 sales representatives be independently and identically distributed with c.d.f F with corresponding p.d.f. that is uniform on [400, 600]. Let G be another c.d.f. with corresponding p.d.f. that is uniform on [0, 1,000]. Clearly F and G have the same mean and G differs from F by an MPS about the mean. Suppose that one of the 10 sales representatives, say Cindy, obtains an opportunity to switch her sales distribution from F to the more risky distribution G at no cost. Assuming that Cindy is an expected utility maximizer with a nondecreasing utility of the payoff, she will switch to G from F if and only if her probability of "winning" (achieving a sales level among the top 3) with G is at least as high as that with F. Given the symmetrical nature of the contest, Cindy's probability of winning with F is simply $3/10 = 0.3$. If Cindy switches her sales distribution to G, her probability of winning becomes P{Cindy sells between 400 and 600 units and wins} + P{Cindy sells between 600 and 1,000 units} = 3/10(200/1,000) + 400/1,000 = 0.46. Here, it appears that Cindy is better off by increasing the risk in her performance. Of course, in doing so, she will also increase the probability of getting the lowest sales level among the ten contestants. However, whether she obtains the lowest sales or the fourth highest is of no consequence, and what matters is whether she can increase her probability of obtaining a sales level that is among the top 3.

Now, suppose that sales representatives with the top 7, and not top 3, sales levels get a bonus. In this case, Cindy's probability of winning (achieving a sales level among the top 7) with F is 0.7, and if she switches to G the probability becomes 0.54. In this case, it appears that Cindy is better off by remaining with the less risky distribution. Table 1 shows the difference between probability of winning with G and probability of winning with F for Cindy for different values of k, where k is the number of winners out of 10 who get the bonus B. Note that adopting G is beneficial for Cindy if and only if $k < 5$. Also, given $k < 5$, the gain from adopting a more risky distribution is higher for a lower k. On the other hand, given $k > 5$, the loss in probability of winning from an increase in risk is higher as k gets higher. To sum up, the above example suggests that if the proportion of winners is low, an MPS works to one's advantage; on the other hand, if the proportion of winners is high, an MPS reduces the probability of winning. This phenomenon is discussed more formally below.

Proposition 3. *Consider n sales representatives, $n \geq 2$, engaged in a rank-order contest with i.i.d. sales levels X_i, $i = 1, 2, \ldots, n$. Each X_i has continuous uniform distribution on the interval $[m - v, m + v]$ and c.d.f. F. Let $X_{1:n} \leq X_{2:n} \leq \ldots \leq X_{n:n}$ be the order statistics obtained by arranging the sales levels in an increasing order of magnitude. Contestants with the highest k sales levels ($X_{n-k+1:n}$ to $X_{n:n}$), $1 \leq k \leq n - 1$, are to be the winners and each gets payoff $S = A + B$, and the remaining $n - k$ contestants get payoff $S = A$ each, where A and B are strictly positive. Let G and H be the c.d.f.s of two other continuous uniform distributions such that G differs from F by an MPS about m (i.e., G is more risky than F) and H differs from F by an MPC about m (i.e., H is less risky than F), Then, any one sales representative who is an expected utility maximizer with a nondecreasing utility function U(S), if given the opportunity, will (weakly) prefer G to F if and only if k/n is small, i.e., if and only if $k/n \leq 1/2$; and, will (weakly) prefer H to F if and only if k/n is large, i.e., if and only if $k/n \geq 1/2$.*

Proof. See the Appendix.

The preferences in Proposition 3 will be strict preferences if and only if $k/n \neq 1/2$ and G and H are not identical to F. It is easy to verify from (A7) in the proof of Proposition 3 that the net gain from switching from F to G is greater for a lower k/n. Similarly, the benefit of switching from F to H will be greater for a higher k/n. In other words, the smaller (greater) the proportion of winners in a contest the greater is the benefit from choosing more (less) risk in performance.[5]

Proposition 4 considers the possibility that all contestants might have an equal opportunity to choose the riskiness of their performance distributions.

Proposition 4. *Consider n sales representatives, $n \geq 2$, engaged in a rank-order contest with sales levels given by random variables $X_1, X_2, \ldots, X_n$. Let $X_{1:n} \leq X_{2:n} \leq \cdots \leq X_{n:n}$ be the order statistics obtained by arranging the sales levels in an increasing order of magnitude. Contestants with the highest k sales levels ($X_{n-k+1:n}$ to $X_{n:n}$), $1 \leq k \leq n - 1$, are to be the winners and each gets payoff $S = A + B$, and the remaining $n - k$ contestants get payoff $S = A$ each, where A and B are strictly positive. Suppose that each of the n contestants has a choice between c.d.f.s G and F as a distribution for her sales, where G and F are c.d.f.s of uniform distributions and G differs from F by an MPS about m (i.e., G is more risky than F). Let $U_i(d_1, d_2, \ldots, d_n)$, where $d_i = G$ or F for all i, be the expected utility for contestant i as a function of everyone's strategies including her own. Further*

Table 1 **The Impact of Adopting an Increase in Risk in a Rank-Order Contest with 10 Contestants for Different Number of Winners *k***

	k								
	1	2	3	4	5	6	7	8	9
$P_G\{\text{Win}\} - P_F\{\text{Win}\}$	0.32	0.24	0.16	0.08	0	−0.08	−0.16	−0.24	−0.32

[5]Here, we do not consider effort as a decision variable for a sales representative. However, the discussion regarding effort as an additional decision variable in the case of quotas in §3 is valid for contests also. A sales representative is likely to face a tradeoff between disutility of effort and adopting higher risk in performance. For a greater disutility of effort, a sales representative is more likely to attempt attaining a higher rank-order in a contest by adopting higher risk in performance rather than by expending greater effort.

assume that each contestant is an expected-utility maximizer with a nondecreasing utility function for the payoff. Then,

(a) if $k/n < 1/2$, the vector of strategies $(G, G, \ldots, G)$ where all contestants choose the more risky distribution is a Nash equilibrium point, and $(F, F, \ldots, F)$ where all contestants choose the less risky distribution is not a Nash equilibrium point.

(b) if $k/n > 1/2$, the vector of strategies $(F, F, \ldots, F)$ where all contestants choose the less risky distribution is a Nash equilibrium point, and $(G, G, \ldots, G)$ where all contestants choose the more risky distribution is not a Nash equilibrium point.

(c) if $k/n = 1/2$, the vector of strategies $(F, F, \ldots, F)$ where all contestants choose the less risky distribution, and $(G, G, \ldots, G)$ where all contestants choose the more risky distribution, is a Nash equilibrium point.

Proof. See the Appendix.

In the proof of Proposition 4, we also demonstrate uniqueness of Nash equilibria in (a) and (b) for the case of $n = 3$. A more general proof for uniqueness is beyond the scope of this paper.

The results of this section have important implications for sales contests and for contests in general. Any contestant who is able to obtain a special opportunity to manipulate the riskiness of his or her performance would have a clear substantive advantage. If all contestants have an equal opportunity to manipulate the riskiness of their performances, a contest that ends with a small proportion of winners might induce a collective behavior that is risk seeking and, on the other hand, a contest with a high proportion of winners might lead to collective behavior that is risk averse. These implications are relevant, of course, for all contests and not just sales contests. Other examples are R&D races, promotion tournaments in organizations, contests among financial fund managers to be in the "top ten" list, etc.

5. Experimental Studies

Five experiments were conducted to test the predictions of the analyses in §§3 and 4. The subjects assumed the role of sales representatives who had to either meet some sales quota targets or participate in a rank-order sales contest. The task required them to select from alternative sales distributions that varied in riskiness. Real monetary incentives were provided to subjects.

Experiment 1

The objective of this study was to test Proposition 1. Proposition 1 implies that higher quota levels result in the selection of more risky distributions. A single factor between subjects design with two levels (two-quota levels) was used. The subjects were 66 MBA students enrolled in an introductory marketing management class. A $50 lottery was used as an incentive to volunteer for the experiment. Subjects were told that they were participating in a decision-making experiment. Before the main task, subjects' inherent risk aversion was assessed by responses to three questions (Clemen 1996). In the first question, the subjects were asked to choose between receiving $500 for certain or participating in a lottery that would give them $1,000 with probability 0.5 and $0 with probability 0.5. In the next two questions, subjects were asked to state the most they would be willing to pay to play two lotteries. The first lottery (Lottery 1) had a 50% chance of winning $1,000 and a 50% chance of getting $0. The second lottery (Lottery 2) had a 80% chance of winning $1,000 and a 20% chance of winning $0.

In the main task, the subjects were asked to play the role of sales representatives selling an industrial product called Beta. They were told that the firm employing them was implementing an incentive scheme for the upcoming quarter. In a memo from senior management, they were informed that they would get a bonus if they equaled or exceeded their individual sales quota set for the quarter. They were provided with the sales quota design which was manipulated with the sales quota being either 350 units or 650 units. Subjects were told that they would be paid $10 if they met the sales quota. Next, the market structure was described. The market for product Beta consisted of 4 types of customer segments (called Type A to Type D) which varied in terms of the responsiveness to sales effort. The subjects were instructed that they could focus their effort on only one segment and that their task was to make a decision on the segment type. They were provided with the characteristics of each segment, which were essentially the sales potential for the four segments. The sales estimate for each segment was a discrete uniform distribution: 300 to 700 units for Segment

A, 200 to 800 units for Segment B, 100 to 900 units for Segment C, and 0 to 1,000 units for Segment D. Thus, if a subject, for example, selected Segment A, his/her sales for the upcoming quarter was bounded from below by 300 units and bounded from above by 700 units. It was repeatedly emphasized to the subjects that all sales numbers in a given range were equally likely. Note that the expected value of sales is 500 for all segments but the variance increases from Segment A to Segment D. All four distributions for the four segments differ from each other by an MPS about the mean such that Segment D is the most risky while Segment A is the least risky.

Subjects were told that, after selecting the segment type, they would draw a card from a box corresponding to the segment type selected. Box A contained cards for each number between 300 and 700, Box B contained cards for numbers ranging between 200 and 800, etc. The number drawn by a subject represented his/her sales level for the quarter. If the number drawn equaled or exceeded the sales quota, the subject was entitled to $10. Finally, following a debriefing session, the winning subjects were paid.

Results and Discussion of Experiment 1

First, responses to the three risk-aversion questions were analyzed which showed that there were no significant differences in the inherent risk preferences across the two conditions (the two-quota levels).[6] Table 2a provides the probabilities for equaling or exceeding the quota levels for the different distributions. The results of the main task are given in Table 2b. The results indicate that most subjects tended to select the segment type with the least risky distribution (63%) when the sales quota was set low. However, when the sales quota was set high, most subjects (74%) selected the segment type associated with the most risky distribution. These results clearly provide strong support for the analysis of quota-based compensation in §3.

Experiment 2

The objective of Experiment 2 was to test Proposition 2. Proposition 2 differs from Proposition 1 in that the bonus is not just a fixed amount but is larger for higher values of sales beyond the quota. While Proposition 2 allows for any nonnegative and nondecreasing functional form for the sales-dependent bonus beyond a quota, we tested the proposition for the linear case. The design was identical to Experiment 1 except for the incentive structure. The subjects were told that they would get a bonus of $10 if they met the quota and would also get 5 cents for every unit sold in excess of the quota. Note that, in testing Proposition 2, our interest is only in the high-quota case (quota = 650). However, we also included the low-quota case (quota = 350) in the experiment. The subjects were 54 evening MBA students enrolled in an introductory operations research class.

Results and Discussion of Experiment 2

Table 3a provides the expected payoffs for each segment type. In the high-quota case, the expected payoff rises steadily from the least risky distribution to the most risky distribution—the expected payoff with the most risky distribution is more than three times the expected payoff with the least risky distribution. In the low-quota case, not surprisingly, the expected payoff does not change much across the distributions. However, it is still highest for the least risky distribution, though not by much. The results of the main task are given in Table 3b.[7] In the high-quota case, the majority of subjects (64%) selected the segment type associated with the most risk and the rest were fairly evenly dis-

[6]In terms of the first risk preference question, there was no significant difference between the two conditions: the percentage of subjects who preferred the $500 for certain versus the equivalent fair lottery was 82.86% in the low-quota group and 80.65% in the high-quota group. Lottery 1 (Lottery 2) refers to the willingness to pay to play a lottery where there is a 50% (80%) chance of winning $1,000 and 50% (20%) chance of winning nothing. The mean willingness to pay for Lottery 1 in the low-quota condition (X_{350} = $86.02) was not significantly different from the mean willingness to pay in the high-quota condition ($X_{650} = 90.16$; $F < 1$, $p < 0.89$). Similarly, the mean willingness to pay for Lottery 2 was not significantly different across the two conditions ($X_{350} = 181.02$, $X_{650} = 178.90$; $F = 0.01$, $p < 0.96$).

[7]Responses to the three risk-aversion questions were also analyzed. The percentage of subjects who preferred the $500 for certain versus the equivalent fair lottery was 84.62% in the low-quota group and 92.86% in the high-quota group. The mean willingness to pay for Lottery 1 in the low-quota condition (X_{350} = $129.80) was not significantly different from the mean willingness to pay in the high-quota condition ($X_{650} = 88.82$; $F = 1.26$, $p < 0.27$). Similarly, the mean willingness to pay for Lottery 2 was not significantly different across the two conditions ($X_{350} = 259.85$, $X_{650} = 221.04$; $F = 0.42$, $p < 0.52$).

Table 2a **Probabilities of Equaling or Exceeding Quotas with Different Distributions**

	Segment A (300–700)	Segment B (200–800)	Segment C (100–900)	Segment D (0–1,000)
Quota: 350	0.88	0.75	0.69	0.65
Quota: 650	0.13	0.25	0.31	0.35

Table 2b **Choice of Riskiness in Response to the Two Quotas—Number (Proportion) of Respondents**

	Probability Distributions				
	Segment A (300–700)	Segment B (200–800)	Segment C (100–900)	Segment D (0–1,000)	Total
Quota: 350	22 (0.63)	7 (0.20)	4 (0.11)	2 (0.06)	35
Quota: 650	0 (0.00)	1 (0.03)	7 (0.23)	23 (0.74)	31

Table 3a **Expected Values of the Payoffs (in $) for Different Distributions**

	Segment A (300–700)	Segment B (200–800)	Segment C (100–900)	Segment D (0–1,000)
Quota: 350	31.72	29.06	28.36	28.44
Quota: 650	5.47	11.56	15.23	17.94

Table 3b **Choice of Riskiness in Response to the Two Quotas—Number (Proportion) of Respondents**

	Probability Distributions				
	Segment A (300–700)	Segment B (200–800)	Segment C (100–900)	Segment D (0–1,000)	Total
Quota: 350	13 (0.50)	8 (0.31)	1 (0.04)	4 (0.15)	26
Quota: 650	3 (0.11)	5 (0.18)	2 (0.07)	18 (0.64)	28

tributed across the other segment types. These results provide strong evidence in favor of Proposition 2. Although Proposition 2 does not provide any predictions for the low-quota case, it is interesting to note that 81% of the subjects chose the two least risky segment types.

Experiment 3

The results of §4 regarding contest-based compensation imply that the decision to take risky actions on the part of the sales representatives is contingent on the design of the contest. If the proportion of winners in a contest is small, the contestants are likely to select more risky distributions relative to a contest where the proportion of winners is large. Experiment 3 was designed to validate this result.

A single factor between subjects design with two levels (proportion of winners as 10% and as 90%) was used. Fifty-six students enrolled in a marketing elective course participated in the experiment.[8] A $50 lottery was used as an incentive to volunteer for the experiment. As in the earlier experiments, the subjects were asked to play the role of sales representatives. They were told that the firm employing them was conducting a sales contest for the upcoming quarter, and the task began with elicitation of the inherent risk preferences.

For the main task, subjects were instructed that they would be competing against the other participants in the class session, where all participants were employed by the same organization. The subjects were also to assume that all participants were equal in terms of selling ability and selling effort. Next, the contest design was explained. The subjects were told that their sales would be compared to those of the other participants in the experiment. In the low-proportion-of-winners condition, a subject had to obtain sales which was among the highest 10% in the group to get the sales bonus. The instructions, for example, were ". . . if your sales are in the highest 10% in your group, you will get the bonus of $10. If you are not in the top 10% in sales (i.e., you are in the bottom 90%), you will get nothing." In the high-proportion-of-winners condition, the proportion of winners was 90%.

The description of the market structure was similar to the setup in the first two experiments. However, the subjects could choose between only two segment

[8] Approximately 40% of the students were executives enrolled in an evening MBA program and the remaining students were full-time MBA students. The average work experience was 5.23 years.

types. The sales estimate for Segment A ranged between 400 and 600 units while that of Segment B ranged between 0 and 1,000 units, with each number in a given range being equally likely. After all the subjects had drawn cards from the boxes corresponding to their choices of segment type, the results were tabulated and the winners were paid \$10 each.

Results and Discussion of Experiment 3

The results of the main choice task in Experiment 2 are provided in Table 4.[9] Approximately 85% of the subjects in the low-proportion-of-winners condition selected the segment with the high-risk distribution. Also, as expected, 72% of the subjects in the high-proportion-of-winners conditions selected the low-risk distribution. These results provide strong support for the implications suggested in §4, i.e., a low proportion of winners in a contest induces high-risk behavior while a high proportion of winners leads to low-risk behavior.

Experiment 4

Recall that, in §4, Nash equilibrium for a sales contest is discussed for the case where choices entail only two distributions. A similar model does not appear to be mathematically tractable for choices between a larger set of distributions. However, this additional experiment was designed to explore whether the intuition from the model is also valid when subjects select from more than two distributions.

This study was identical to Experiment 3 in all aspects except that the choice of distributions on the part of a subject was among five distributions, rather than just two, and four levels for proportion of winners were used. The subject pool was MBA students from both the first and second years. A total of 182 subjects participated in the experiment. A single factor between subjects' design with 4 levels (proportion of winners equal to 10%, 40%, 60%, and 90%) was employed. As in the earlier experiments, measures of risk preferences were first obtained. For the main task, in contrast to Experiment 3, the subjects could select from 5 discrete uniform distributions (400 to 600, 300 to 700, 200 to 800, 100 to 900, and 0 to 1,000). All the other procedures were identical to those in Experiment 3.

Results and Discussion of Experiment 4

The results of the main task are provided in Table 5.[10] The data indicate that the intuition of the model in §4 still holds in more complex setups of contest-based compensation. In the case with 10% winners, 74% of the respondents chose Segment E and 15% chose D, the two most risky segments, whereas no one chose the least risky Segment A. On the other hand, with 90% winners, most subjects chose Segment A (22%) or Segment B (49%), the two least risky segments, and only two respondents (4%) chose the most risky Segment E. Such effects held also for the cases of 40% and 60% winners, though were a bit muted. In the 40% winners case, 62% still chose Segments D or E and only 15% chose Segments A or B; in the 60% case, 41% chose Segments D or E and 48% chose Segments A or B. The effects are not as strong in these cases, perhaps due to

Table 4 Choice of Riskiness in Responses to Proportion of Winners in the Contest—Number (Proportion) of Respondents

	Probability Distributions		
	Segment A (400–600)	Segment B (0–1,000)	Total
Proportion of Winners: 10%	4 (0.15)	23 (0.85)	27
Proportion of Winners: 90%	21 (0.72)	8 (0.28)	29

[9]Checks revealed no significant differences in the inherent risk preferences across the two conditions. In the low-proportion-of-winners condition, 81.48% of the subjects preferred the option of \$500 for certain, while 72.41% preferred the same option in the high-proportion-of winners condition (the difference was not significant). The responses to Lottery 1 ($X_{10\%}$ = \$106.00, $X_{90\%}$ = \$86.75; $F = 0.22$, $p < 0.64$) and Lottery 2 ($X_{10\%}$ = 203.15, $X_{90\%}$ = 242.96; $F = 0.29$, $p < 0.59$) also showed no significant differences across the two conditions.

[10]As in the earlier experiments, there were no significant differences in the inherent risk preferences across the different conditions. In question 1, the percentages of the subjects who preferred the option of \$500 for certain were 71.74%, 75.56%, 78.26%, and 77.78% for the 10%, 40%, 60%, and 90%, proportion-of-winners conditions, respectively. The means of willingness to pay for Lottery 1 ($X_{10\%}$ = 135.60, $X_{40\%}$ = 128.18, $X_{60\%}$ = 106.93, $X_{90\%}$ = 105.16; $F = 0.38$, $p < 0.77$) and for Lottery 2 ($X_{10\%}$ = 251.5, $X_{40\%}$ = 242.93, $X_{60\%}$ = 233.56, $X_{90\%}$ = 192.48; $F = 0.44$, $p < 0.73$) were also not significantly different.

Table 5 Choice of Riskiness in Response to Proportion of Winners in the Contest—Number (Proportion) of Respondents*

	Probability Distributions					
Proportion of Winners	Segment A (400–600)	Segment B (300–700)	Segment C (200–800)	Segment D (100–900)	Segment E (0–1,000)	Total
10%	0 (0.00)	3 (0.07)	2 (0.04)	7 (0.15)	34 (0.74)	46
40%	2 (0.04)	5 (0.11)	10 (0.22)	9 (0.20)	19 (0.42)	45
60%	9 (0.20)	13 (0.28)	5 (0.11)	8 (0.17)	11 (0.24)	46
90%	10 (0.22)	22 (0.49)	5 (0.11)	6 (0.13)	2 (0.04)	45

*The proportions in rows 2 and 4 do not add to 1 due to rounding.

the fact that the benefit of adopting greater risk or less risk is less when the proportion of winners is closer to 50%.

Experiment 5[11]

Experiment 5 was conducted in two parts to obtain some process measure to explain why all subjects were not selecting the segment type predicted by the models. The procedures followed were identical to the earlier experiments except that the subjects were asked to write their thoughts on why they selected the segment type they did.

Experiment 5(a) was a replication of Experiments 1 and 2 to investigate deviations from Propositions 1 and 2 in the choice behavior. The results of the choices are provided in Table 6(a). The results are very similar to those in Experiments 1 and 2. In the low-quota case of Experiment 1, subjects who chose a distribution other than the predicted lowest-variance distribution (4 out of 21 subjects) did so either because they did not understand the task (75%) or were overconfident in the lottery pick (25%). In the high-quota case of Experiment 1, 6 out of 24 subjects did not select the predicted highest-variance segment, and the protocol analysis revealed that 5 of these 6 subjects (83.33%) were confused about the task. Proposition 2 predicts that in the high-quota case of Experiment 2, subjects would select the most risky segment (Segment D). However, the pattern

[11]We thank the editor and an anonymous referee for suggesting this analysis.

Table 6a Choice of Riskiness in Response to the Three Quotas—Number (Proportion) of Respondents

	Probability Distributions				
	Segment A (300–700)	Segment B (200–800)	Segment C (100–900)	Segment D (0–1,000)	Total
Quota: 350	17 (0.81)	1 (0.05)	0 (0.00)	3 (0.14)	21
Quota: 650 $S(x) = A + B$	2 (0.08)	0 (0.00)	4 (0.17)	18 (0.75)	24
Quota: 650 $S(x) = A + \phi(x)$	2 (0.08)	3 (0.13)	2 (0.08)	17 (0.71)	24

Table 6b Choice of Riskiness in Response to the Three Quotas—Number (Proportion) of Respondents Adjusted

	Probability Distributions				
	Segment A (300–700)	Segment B (200–800)	Segment C (100–900)	Segment D (0–1,000)	Total
Quota: 350	15 (0.94)	0 (0.00)	0 (0.00)	1 (0.07)	16
Quota: 650 $S(x) = A + B$	0 (0.00)	0 (0.00)	1 (0.06)	16 (0.94)	17
Quota: 650 $S(x) = A + \phi(x)$	0 (0.00)	0 (0.00)	0 (0.00)	16 (1.00)	16

of results obtained in Experiments 2 and 5(a) show that this was not the case (compared to the high-quota case of Experiment 1, a larger percentage of subjects did not select the most risky Segment D). This was explained by the protocols which indicated that the calculation of expected values for the compensation function $S(x) = A + \phi(x)$ in Experiment 2 was cognitively more complicated than for $S(x) = A + B$ in Experiment 1.

Since the analysis shows that some subjects did not understand the task, a germane issue is whether any subjects who made the predicted choice did so without understanding the task. We reexamined the data after deleting all observations of subjects who, based on the cognitive response data, did not appear to understand the task. The adjusted results are reported in Table 6(b). Comparing Tables 6(a) and 6(b) shows that 88.24% of the subjects in the low-quota condition, 88.89% in the high-quota condition of $S(x) = A + B$, and 94.12% in the high-quota condition of $S(x) = A + \phi(x)$, selected the predicted choice for the theoretical reasons advanced in the paper. These results clearly indicate that most subjects who made the theoretically correct choice did so because they intuitively understood that they were maximizing their probability of earning the bonus.

In Experiment 5(b), the proportion-of-winners condition of Experiment 4 was manipulated (out of the four levels of the proportion-of-winners condition in Experiment 4, two levels, 10% and 90%, were used). The results are provided in Table 7(a). Four categories emerged as reasons for subjects not selecting the lowest-variance distribution when the proportion of winners was high (90%): (a) Lack of Task Understanding (42%)[12]—subjects did not comprehend the task due to difficulty of language, misunderstood the problem, or found the task too complicated cognitively; (b) A Desire for Some Risk Taking (37%)—this reflected a desire for adopting some element of risk in performance;[13] (c) Overconfidence (11%)—overestimation of the chances of obtaining a good draw; and (d) Following the Crowd (11%)—an assumption that most subjects would engage in at least some risk. When the proportion of winners was low (10%), subjects who did not select the highest-variance distribution did so because they did not understand the task (67%) or were averse to the possibility of obtaining low sales numbers (33%).

As before, we also checked whether subjects who made the predicted choice did so using the logic of the model. As in Experiment 5(a), the data was reexamined after adjusting for subjects who did not understand the task. The results are presented in Table 7(b). The percentage of subjects who made the predicted choice using the correct rationale was 86.96% and 76.92% for the 10% and 90% proportion-of-winners conditions, respectively.

Overall, Experiment 5 provides strong evidence that subjects understood and applied the intuition developed in the models. After adjusting for subjects who did not understand the task, the results remain consistent with the theory and the results of Experiments 1–4.

6. Conclusion and Managerial Implications

The existing literature on compensation plans has primarily focused on one component of decision making on the part of the sales representatives: the amount of effort to be expended in the selling task. A major point of this research is that sales representatives may also make decisions on how much risk to undertake in the selling task. For example, consider the case where a sales representative, trying to increase sales, must allocate a given amount of effort on the low-risk approach of pursuing a small set of existing customers or incur the same effort on the high-risk option of getting new larger customers to switch from competitors. Similarly, sales representatives may make decisions to expend effort on retaining a small but satisfied customer segment or on a more risky and large but dissatisfied segment.

One of the assumptions included in most of the normative models on salesforce compensation concerns

[12]Of the subjects not selecting the choice predicted by the model, 42% did not understand the task.

[13]Typical protocols obtained were "I will take some risk but too much of it can mean I won't be in the top 90%," and "I thought choosing Segment A would be boring because there is no challenge to it and Segment B has a little—so I chose B."

Table 7a Choice of Riskiness in Response to Proportion of Winners in the Contest—Number (Proportion) of Respondents

	Probability Distributions					
Proportion of Winners	Segment A (400–600)	Segment B (300–700)	Segment C (200–800)	Segment D (100–900)	Segment E (0–1,000)	Total
10%	1 (0.03)	3 (0.09)	2 (0.06)	3 (0.09)	23 (0.72)	32
90%	13 (0.41)	11 (0.34)	2 (0.06)	3 (0.09)	3 (0.09)	32

Table 7b Choice of Riskiness in Response to Proportion of Winners in the Contest—Number (Proportion) of Respondents Adjusted

	Probability Distributions					
Proportion of Winners	Segment A (400–600)	Segment B (300–700)	Segment C (200–800)	Segment D (100–900)	Segment E (0–1,000)	Total
10%	0 (0.00)	0 (0.00)	1 (0.04)	2 (0.09)	20 (0.87)	23
90%	10 (0.48)	7 (0.33)	0 (0.00)	1 (0.05)	3 (0.14)	21

the risk preferences of the firm's employees. Often it is suggested that the employees are either risk averse (e.g., Basu et al. 1985; Lal and Staelin 1986) or risk neutral (Rao 1990; Mantrala et al. 1997). Alternatively, it is recommended that a firm elicit risk preferences of its employees (Raju and Srinivasan 1994). Based on the knowledge of the risk preferences, the models are used to design incentive schemes so that the interests of the sales representatives are aligned with the objectives of the firm. Elicited preferences, or assumptions, which regard sales representatives as being risk averse or risk neutral might lead to the conclusion that the sales representatives cannot be expected to engage in high-risk sales activities. While this would be true if the sales representatives are facing only a piece-rate compensation scheme, we show, in this paper, that this need not be the case when quota-based or contest-based compensation schemes are used. In other words, we show that risk behavior is not exogenous but endogenous to the compensation plans.

More specifically, we have shown, theoretically and experimentally, that the risk behavior of sales representatives is influenced by the payoff structure of the quota-based and contest-based compensation schemes. A high quota or a low proportion of winners in a rank-order contest induces sales representatives to opt for high-risk prospects. A low quota or a high proportion of winners in a rank-order contest, on the other hand, leads to sales representatives choosing low-risk prospects. It is not the case that the inherent risk attitudes of the sales representatives are being altered or the standard expected utility paradigm is being violated. It is just that the expected utility for a risk-averse manager is higher with a more risky alternative in some cases and, similarly, the expected utility for a risk-seeking manager is higher with a less risky prospect in some other cases. In this sense, it is important to note that such high-risk or low-risk behavior on part of the sales representatives might be contrary to what might have been concluded from their risk preferences independently of the specific incentive scheme.

Quotas are typically set taking into consideration the sales representative and territory characteristics (Stanton et al. 1991). An insight from this paper is that a firm should also take into account the strategic objectives of the product line/brand. Setting a quota in terms of a basic sales level could induce the sales representative to meet the short-term quota goal by either adopting a high-risk or a low-risk strategy. However, the customer base obtained by the sales representative may not be the most desirable (for example, with a high-risk strategy, the firm might end up with price-sensitive consumers or brand switchers). The results suggest that the firm could be better off by differentiating quota goals by segment types (e.g., new customers versus retaining existing customers). Such an approach would align the focus of sales representatives to be more in line with the long-term goals of the firm.

This paper also presents implications for contest-based compensation schemes. For instance, a firm that employs a severe contest where there are only very few winners is likely to face a collective behavior that is high in risk. On the other hand, in a case where most contestants are declared as winners, the firm sponsoring the contest would face low-risk behavior. Whether the resulting behavior is favorable or detrimental to the objectives of the firm would further depend on the context in which the firm is operating. For example, the firm might either be engaged in an aggressive contest over market share with other firms or it might be engaged in protecting its presence in a market.

The model for contests proposed here implicitly assumes a single period framework.[14] The players do not get feedback on relative performance levels during the course of a contest or make multiple decisions on risk behavior. If the duration of a contest is long, managers may have the opportunity to adjust their risk decisions on the basis of the performance levels of other employees. In such cases, it is likely that the high-risk behavior of salespeople who are lagging behind will be accentuated towards the end of the contest.

We acknowledge that situations may exist where the fraction of compensation that is quota-based or contest-based might be small relative to the total compensation. Our model would still predict the results shown in this paper, although we did not test for this specifically in the experimental studies. It might be worth noting that, for an individual participant, the utility associated with exceeding a quota or winning in a contest might be dependent not just on the monetary rewards (which, in some cases, might be insignificant relative to total compensation) but also on whether one is regarded as a "loser" or a "winner" in an organization (thus enhancing the impact of exceeding a quota or winning in a contest).

[14]We thank an anonymous referee for this point.

While this paper discusses the context of salesforce compensation, the implications of contest designs can be generalized to many other situations where the payoffs are based on relative performance. For example, in the new product development process, some market characteristics such as the length of the product life cycle or competitive behavior may require portfolios of high-risk R&D projects. The firm should set up incentive structures so that the decisions made by the product managers are compatible with the objectives of the firm. At a broader level, similar implications hold for tournaments for promotion to a limited number of higher management positions in organizations, management of portfolio managers who compete for the substantial rewards associated with being in the list of top few mutual funds, etc.

Directions for Future Research

The question of exactly how high or low the quota levels or the proportion of winners in a contest should be set, given the firm's objectives, remains to be explored. Clearly, if a firm would like to dampen high-risk behavior on the part of the sales representatives, lowering quota levels or increasing the proportion of winners in contests might do so. Similarly, in order to reduce conservatism towards high-risk behavior, moving up the quota levels or reducing the proportion of winners in contests could be useful.

Another interesting question concerns the use of quotas versus rank-order contests. Determining the proportion of participants likely to succeed in a quota-based plan requires an assessment of the performance distributions by the firm even if all participants are considered to be equally able, whereas that is not necessary with rank-order contests. In this respect, contests are likely to reduce the uncertainty regarding the total compensation costs faced by the firm. However, a quota-based scheme might have other advantages.

This paper focuses on risk as a decision variable. As pointed out earlier, the amount of effort to expend is also a key decision made by sales representatives. It appears very plausible to us that at any fixed level of effort, a manager is likely to have choice over the riskiness in performance—the case discussed in this paper. Nevertheless, it would be interesting to formally extend the model to also include effort as a decision variable. The impact of quota schemes on the effort decision has been examined in the literature (Mantrala, et al. 1997; Raju and Srinivasan 1994). In context of our model, higher effort could be considered to result in a higher mean of the sales distribution, as shown briefly in § 3. It is our speculation that in contests where the proportion of winners is very small and with very high quotas, the advantage of taking high risk in performance is likely to overwhelm any advantage gained by simply moving the mean of the sales distribution to a higher level by expending greater effort. In other words, in such cases, a manager who takes greater risk is more likely to succeed compared to another manager who simply puts in greater effort. Moreover, the impact of effort is likely to be bounded from above, beyond which greater risk would be the only way to maximize chances of meeting a high quota or winning in a contest with a small proportion of winners.

Finally, we acknowledge the importance of also considering the problem of setting up incentives for a heterogeneous salesforce and understanding the resulting implications. Heterogeneity in a salesforce may occur due to a variety of reasons (e.g. Raju and Srinivasan 1994). Heterogeneity implies that the sales response function (with respect to effort) could vary among employees or that the sales representatives have different disutility of effort. One reason for the difference in the sales response functions could be due to the different inherent effectiveness of the sales representatives. Other reasons could be due to exogenous factors such as the different sales potential of the various territories. The behavior of sales representatives who are either disadvantaged due to their ability or perceive the incentive schemes to be unfair is an important issue to consider. If the perceived disadvantage is high, employees may elect not to participate. However, given that a group of representatives decide to participate in an incentive scheme, our prediction is that a disadvantaged manager is likely to engage in greater risk relative to an advantaged manager, regardless of the proportion of winners in a contest or any given level of quota. Consider, for example, a disadvantaged sales representative who would on average generate lower sales than other representatives in the firm. High-risk behavior will probably be the optimal strategy to overcome the inherent disadvantage and win the contest or clear a set quota. We defer a more detailed analysis of this problem to future research.[15]

Appendix

Proof of Proposition 1. The sales representative will choose G over F if and only if her expected utility is at least as high with G as with F, which implies if and only if her probability of getting the bonus B is at least as high with G as with F. The increase in probability of getting the bonus by choosing G over F is given by

$$\Phi(G, F) = P_G\{x \geq q\} - P_F\{x \geq q\} = \int_q^\infty dG(x) - \int_q^\infty dF(x) = [1 - G(q-)] - [1 - F(q-)] = F(q-) - G(q-), \quad (A1)$$

where $F(q-) = P_F\{x < q\}$ and $G(q-) = P_G\{x < q\}$. Recall that,if G differs from F by an MPS about c, then $G(x) \geq F(x)$ for $x < c$ and $G(x) \leq F(x)$ for $x \geq c$. Hence, $\Phi(G,F)$ in (A1) is nonnegative iff $q > c$.

Proof of Proposition 2. The sales representative will (weakly) prefer G to F if and only if her expected utility is at least as high with G as with F. The increase in expected utility by choosing G over F is given by

$$\Delta U\ (G, F) = E_G[U(S(x))] - E_F[U(S(x))] = \int_0^{q-} U(A)d[G(x) - F(x)] + \int_q^\infty U(A + \phi(x))d[G(x) - F(x)]. \quad (A2)$$

The first integral in (A2) can be rewritten as

$$\int_0^{q-} U(A)d[G(x) - F(x)] = U(A)[G(q-) - F(q-)], \quad (A3)$$

and integrating the second integral in (A2), by parts, and letting $U'(A + \phi(x)) = dU(A + \phi(x))/dx$, yields

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$$\int_q^\infty U(A + \phi(x))d[G(x) - F(x)]$$

$$= U(A + \phi(\infty)) \left[\int_q^\infty d[G(y) - F(y)]\right]$$

$$- \int_q^\infty \left[\int_q^x d[G(y) - F(y)]\right] U'(A + \phi(x))\, dx$$

$$= U(A + \phi(\infty))[F(q-) - G(q-)]$$

$$- \int_q^\infty [G(x) - G(q-) - F(x) + F(q-)]$$

$$\cdot\, U'(A + \phi(x))\, dx = U(A + \phi(\infty))[F(q-) - G(q-)]$$

$$- [F(q-) - G(q-)][U(A + \phi(\infty)) - U(A + \phi(q-))]$$

$$- \int_q^\infty [G(x) - F(x)]U'(A + \phi(x))dx$$

$$= [F(q-) - G(q-)]U(A + \phi(q-)) \tag{A4}$$

$$- \int_q^\infty [G(x) - F(x)]U'(A + \phi(x))dx.$$

Substituting (A3) and (A4) in (A2) yields

$$\Delta U(G, F) = [F(q-) - G(q-)][U(A + \phi(q-)) - U(A)] - \int_q^\infty [G(x) - F(x)]U'(A + \phi(x))dx. \tag{A5}$$

Note in (A5) that, since U is nondecreasing in its argument and ϕ is nonnegative, $[U(A + \phi(q-)) - U(A)]$ is nonnegative. Further, since ϕ is also nondecreasing in x, $U'(A + \phi(x))$ is nonnegative. Recall that if $q > c$, then $G(x) - F(x) \le 0$ for $\forall x \in [q, \infty]$ and $[F(q-) - G(q-)] \ge 0$. Combining all these observations shows that if $q > c$, $\Delta U(G, F)$ is nonnegative.

Proof of Proposition 3. Since G and F are c.d.f.s of continuous uniform distributions and G differs from F by an MPS about m, G is symmetrically more "spread-out" than F around m. Let the support of G be in the interval $[m - v - \Delta v, m + v + \Delta v]$, where $0 < \Delta v < v$. Similarly, since H is symmetrically less spread-out than F around m, let the support of H be in the interval $[m - v + \Delta v, m + v - \Delta v]$, with Δv as defined above.

A sales representative will prefer G to F if and only if her expected utility is at least as high with G as with F, i.e., iff her probability of winning (achieving one of the top k sales levels) is at least as high with G as with F. The probability of winning with G is given by

$$P_G\{\text{Win}\} = \int_{m-v-\Delta v}^{m+v+\Delta v} F_{n-k:n-1}(x)\, dG(x) \tag{A6}$$

where

$$F_{n-k:n-1}(x) = \frac{(n-1)!}{(n-k-1)!(k-1)!} \int_0^{F(x)} u^{n-k-1}(1-u)^{k-1}du$$

is the c.d.f. for $X_{n-k:n-1}$, the $(n - k)$th highest sales level among the $n - 1$ contestants who still face F (see, for example, Arnold et al. 1992). Integrating the righthand side in (A6), by parts, and letting $t = F(x)$, yields

$$P_G\{\text{Win}\} = 1 - \int_0^1 G[F^{-1}(t)]f_\beta(t \mid n-k, n)dt,$$

where

$$G[F^{-1}(t)] = G[m - v + t(2v)] = (2vt + \Delta v)/2(v + \Delta v),$$

and

$$f_\beta(t \mid n-k, n) = \frac{(n-1)!}{(n-k-1)!(k-1)!}\, t^{n-k-1}(1-t)^{k-1}$$

is a beta probability density function. Hence, we get

$$P_G\{\text{Win}\} = 1 - \frac{2v[(n-k)/n] + \Delta v}{2(v + \Delta v)}.$$

For the same sales representative, given the symmetrical conditions in the contest, the probability of winning with F is simply $P_F\{\text{Win}\} = k/n$. Hence the sales representative will prefer G to F iff

$$P_G\{\text{Win}\} - P_F\{\text{Win}\} = \frac{\Delta v}{v + \Delta v}\left(\frac{1}{2} - \frac{k}{n}\right) \ge 0. \tag{A7}$$

Given that $v > 0$ and $\Delta v > 0$, the inequality in (A7) will hold if and only if $k/n \le 1/2$, which implies that a sales representative will switch from F to G if and only if $k/n \le 1/2$. Similarly, the second part of the proposition can be easily seen by substituting H for G and using the appropriate limits for the integral in (A6).

Proof of Proposition 4. A Nash equilibrium point is any vector of strategies $(d_1^*, d_2^*, \ldots, d_n^*)$ such that for each $i = 1, 2, \ldots, n$,

$$U_i(d_1^*, d_2^*, \ldots, d_i^*, \ldots, d_n^*) = \max_{d_i} U_i(d_1^*, d_2^*, \ldots, d_i, \ldots, d_n^*).$$

If $k/n < 1/2$, then, by Proposition 3,

$$\max_{d_i} U_i(F, F, \ldots, d_i, \ldots, F), = U_i(F, F, \ldots G, \ldots F),\ \forall i,$$

and

$$\max_{d_i} U_i(G, G, \ldots, d_i, \ldots G) = U_i(G, G, \ldots G, \ldots, G),\ \forall i,$$

since $d_i = F$ would be equivalent to choosing an MPC about m which is preferred if and only if $k/n > 1/2$. So, $(G, G, \ldots, G)$ is a Nash equilibrium point, and $(F, F, \ldots, F)$ is not a Nash equilibrium point. By similar reasoning, from Proposition 3, it is easily seen that if $k/n > 1/2$ then $(F, F, \ldots, F)$ is a Nash equilibrium point and $(G, G, \ldots, G)$ is not a Nash equilibrium point, and if $k/n = 1/2$ then both $(F, F, \ldots, F)$ and $(G, G, \ldots, G)$ are Nash equilibrium points.

Uniqueness of the Nash Equilibria in (a) and (b) for $n = 3$. Consider the case when $k/n < 1/2$, with $n = 3$, i.e., only the contestant with the highest sales level is the winner. We then have to show that (G, G, G) is the unique Nash equilibrium point. In other words, we have to show that for any one of the three contestants, say Contestant 1, it is optimal to choose the higher-risk strategy G irrespective of whether the other two contestants choose *G* or *F*. We show above that (*G*, *G*, *G*) is a Nash equilibrium point, i.e. $(\max/_{d_1})\, U_1(d_1, G, G) = U_1\,(G, G, G)$. We also show that (*F*, *F*, *F*) is not a Nash equilibrium, i.e., $(\max/_{d_1})\, U_1(d_1, F, F) = U_1\,(G, F, F)$. Then, what remains to be shown is that $(\max/_{d_1})\, U_1(d_1, G, F) = U_1(G, G, F)$, i.e., it is optimal for Contestant 1 to choose *G* when out of the remaining two contestants one chooses *G* and the other chooses *F*. In other words, letting $P_1(d_1, G, F)$ be the probability that Contestant 1 will win the contest with d_1 (where $d_1 = G$ or F) when out of the remaining two contestants one chooses *G* and the other chooses *F*, we have to show that $P_1(G, G, F) - P_1(F, G, F) > 0$. But,

$$P_1(G, G, F) = \int_{m-v-\Delta v}^{m+v+\Delta v} G(x)F(x)dG(x). \tag{A8}$$

Integrating the right-hand side in (A8) by parts, we get

$$P_1(G, G, F) = 1 - \int_{m-v-\Delta v}^{m+v+\Delta v} G(x)F(x)dG(x) - \int_{m-v}^{m+v} G(x)G(x)dF(x),$$

i.e.,

$$P_1(G, G, F) = 1/2[1 - P_1(F, G, G)].$$

Similarly, it can be verified that

$$P_1(F, G, F) = 1/2[1 - P_1(G, F, F)].$$

So, we now have to show that

$$P_1(G, G, F) - P_1(F, G, F) = 1/2\,[P_1(G, F, F) - P_1(F, G, G)] > 0. \tag{A9}$$

Note that, as a direct result of Proposition 3, if $k/n < 1/2$, $P_1(G, F, F) > P_1(F, F, F)$ and $P_1(F, G, G) < P_1(G, G, G)$. But, $P_1(F, F, F) = P_1(G, G, G) = 1/3$. It then follows that the inequality in A(9) holds, i.e., it is optimal for Contestant 1 to choose *G* when out of the remaining two contestants one chooses *G* and the other chooses *F*. This proves that, if $k/n < 1/2$, then (*G*, *G*, *G*) is the unique Nash equilibrium point. By similar reasoning, it can be shown that, if $k/n > 1/2$, (*F*, *F*, *F*) is the unique Nash equilibrium point.

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