

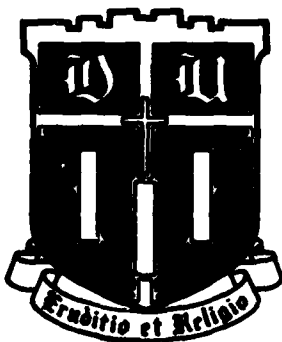
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# LEVEL II

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⑩ MANAGERIAL RISK PREFERENCES  
FOR BELOW-TARGET RETURNS.  
Dan. J. Laughunn and John W. Payne  
Duke University

Roy/Crum

⑨ University of Florida  
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(John W. Payne, Investigator)

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decision process (personal versus managerial). When ruinous losses were introduced for 75 of the managers, 64% switched to risk averse behavior. Empirical findings concerning the relationship between risk preferences for below target returns and several demographic characteristics of managers are also reported.

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## INTRODUCTION

It is conventional practice in the literature dealing with risky choice behavior to assume that decision making agents, e.g., investors, consumer units, managers, and firms, are risk averse everywhere and make choices among alternatives on that basis. The assumption of risk aversion is a basic foundation of contemporary research in business, finance, management science, and economics and is employed in studies of such diverse topics as portfolio theory [22], agency theory [23], moral hazard [12], profit regulation [10], hedging [13], and inventory problems [1]. In its most general form, the assumption of risk aversion is equivalent to an assumption that a decision maker has a utility function for monetary consequences that is uniformly concave. In a variety of other more specific forms, the assumption is defined in terms of an aversion to selected properties of the probability distributions of return which confront the decision maker, e.g., variance [2].

The assumption of risk aversion, however, has not gone unchallenged. Over 30 years ago, Friedman and Savage [7] suggested that risk preferences might be a mixture of risk aversion and risk seeking. Other theoretical, and some empirical, studies supporting a mixture of risk seeking and risk aversion for a single decision maker have followed, e.g., [8], [9], [24], and [25]. Reviews of those studies, and the more general literature on risk taking, are offered by Libby and Fishburn [18] and Crum, Laughhunn, and Payne [3].

Recently, the challenge to the assumption of risk aversion has been incorporated into two new models of risky decision behavior developed by Fishburn [4] and Kahneman and Tversky [14]. Both of these models assume

that outcomes are evaluated with respect to a pre-determined benchmark return (target level or reference point) which is used by a decision maker to translate monetary outcomes into gains or losses.<sup>1</sup> Furthermore, the utility (or value) function is seen as fundamentally different for gains than for losses. Empirical work reported in Fishburn and Kochenberger [5], Kahneman and Tversky [14], and Payne, Laughhunn and Crum [20] suggests that the predominant pattern of risk preference is risk seeking for losses and risk aversion for gains, as opposed to the conventional assumption of risk aversion everywhere.

Given the potential importance of the finding that decision makers may not be risk averse [3], [20], the present paper examines the risk preferences for below target returns (losses) of 237 managers from the U.S., Canada, and Europe. Previous reports of risk seeking attitudes generally have been based on much smaller samples, e.g., data from 28 decision makers in Fishburn and Kochenberger [5], or have used students and university faculty as subjects, e.g., Kahneman and Tversky [14]. Additional empirical evidence about the risk preferences of managers in particular, seems warranted due to the increasing concern with the role of managers in terms of decisions to allocate resources in situations of risk, e.g., capital investments in innovative projects. In addition, the present paper examines the extent to which risk preferences for below target outcomes may be sensitive to ruinous loss considerations. Several writers [3], [14], [18] have suggested that ruinous loss or unacceptable loss considerations will affect risky choice behavior. However, to our knowledge, the empirical base for such an idea is almost nonexistent. Libby and Fishburn [18], for example, seem to base their conclusion regarding



ruinous loss on a very limited amount of interview data reported by Mao [19]. Finally, the present paper examines the extent to which risk attitudes for below target returns are associated with a variety of demographic characteristics of the decision maker.

#### EXPERIMENTAL PROCEDURE

The procedure developed to measure risk preference for below target returns was based on the Fishburn model [4]. In the Fishburn model, also called the  $\alpha$ - $t$  model, the risk of an alternative is defined in terms of two characteristics: (1) an aspiration level or target level of return denoted  $t$  and (2) the relative consequence to the decision maker of falling short of the target return by various amounts. The relative importance of returns below the target is measured by a non-negative parameter called  $\alpha$ . Formally, the risk of an alternative, denoted  $A$ , is a probability weighted function of returns below target given by:

$$R(A) = \int_{-\infty}^t (t-x)^{\alpha} dF(x)$$

where  $F(x)$  is the probability of receiving a return not exceeding  $x$ .

In the  $\alpha$ - $t$  model, the risk of an alternative is combined with its mean return to determine preference. Given any two alternatives  $A$  and  $B$ , having mean returns  $\mu(A)$  and  $\mu(B)$  respectively,  $A$  is preferred to  $B$  if and only if  $\mu(A) \geq \mu(B)$  and  $R(A) \leq R(B)$  with at least one strict inequality holding. The general form of this preference model is a familiar one and belongs to the broad class of dominance models. Based on the specification of  $\alpha$ , the  $\alpha$ - $t$  model includes as special cases mean-risk dominance models

that have been investigated by others. For example,  $\alpha=0$  implies that probability of loss is the appropriate index of risk, whereas  $\alpha=1$  and  $\alpha=2$  imply that expected opportunity loss and target semi-variance are appropriate [11], [16]. More generally, the magnitude of  $\alpha$  relative to 1.0 serves to delineate the importance of returns below target. If the main concern of a decision-maker is failure to achieve the target return without particular regard to the amount that return falls below the target, then a value of  $\alpha$  in the range  $\alpha < 1.0$  is appropriate. On the other hand, a value of  $\alpha$  in the range  $\alpha > 1.0$  implies that the decision maker regards small deviations below target as being relatively harmless when compared to large deviations.

More generally, Fishburn demonstrates that the risk preference for returns below target of a decision maker, in terms of a utility function, is completely described by the magnitude of  $\alpha$  relative to 1.0. If  $\alpha < 1$ , the decision maker will have a convex utility function for returns below target (consistent with risk seeking), whereas if  $\alpha > 1$  the utility function will be concave in this region of return (consistent with risk aversion). Measurement of  $\alpha$  therefore provides a method of assessing whether the decision maker is a risk seeker or a risk averter for below target returns.

The procedure used to estimate  $\alpha$  in the present study incorporated a number of ideas suggested by Fishburn [4]. Basically, the estimation procedure involved an interactive computer program designed to present to an individual decision maker a series of pairs of alternatives to choose from. Each pair of alternatives consisted of either one surething option and one uncertain option, involving two possible returns with associated probabilities, or two uncertain options.

The construction of the initial pairs of alternatives to be presented to a decision maker was based on the values of two experimental parameters  $t$  and  $d$ . The value of  $t$  represented an assumed target level and was always set at  $t=0$ . The parameter  $d$  represented a "noticeable" difference from  $t$ . As suggested by Fishburn, the initial choice problem would then involve one option consisting of a certain loss of the amount  $t-d$ , and one option with a .5 probability of an amount  $t$  and a .5 probability of an amount  $t-2d$ . If, for example,  $d=\$10$ , then the individual would be presented with the following initial choice problem:

Choice of:

<u>A</u>	<u>B</u>
\$ 0 with $p = .5$	
-\$20 with $p = .5$	-\$10 with $p = 1.0$

Note that the expected value of return is the same for both alternatives. This was always the case for all pairs of alternatives.

Now suppose a decision maker chose alternative A from the initial pair given above. This would indicate that  $\alpha < 1.0$  and that the individual would prefer to risk losing \$20, with .5 probability, in order to have the option of achieving the target return, also with .5 probability, rather than be guaranteed a below target return. The individual who had such a preference might then be presented with the following choice problem:

Choice of:

<u>A</u>	<u>B</u>
-\$10 with $p = 1.0$	\$180 with $1-p = .05$
	-\$20 with $p = .95$

Again,  $\mu(A) = \mu(B)$ . In this case, however, the loss of \$20 with alternative B is almost certain, so the individual might prefer alternative A with the smaller amount to lose. If this were the case, the individual would then be presented with a series of further choices involving various values of  $p$  until an indifference was indicated between the sure loss of  $t-d$  and the uncertain alternative having loss  $t-2d$  with probability  $p$  and return  $t+d(2p-1)/(1-p)$  with probability  $1-p$ , where  $p \geq 1/2$ . When the indifference probability  $p_0$  was determined,  $\alpha$  was given by  $\alpha = \log(1/p_0)/\log 2$ . If the uncertain alternative was preferred to the sure loss for all  $p < 1$ , then  $\alpha = 0$ .

In the case where an individual expressed preference for alternative B in the initial choice problem, the value of  $\alpha$  was determined by presenting choice pairs involving two uncertain alternatives. The first uncertain alternative had a relatively small probability  $p$ , i.e.,  $p \leq .25$ , of returning  $t-2d$  and probability  $1-p$  of returning  $t$ , while the second had even chances of returning  $t-d$  and  $t+d(1-4p)$ . When the indifference probability  $p_0$  was determined,  $\alpha$  was given by  $\alpha = \log(1/2p_0)/\log 2$ . If the even-chance alternative was preferred for all  $p > 0$ , then  $\alpha = \infty$ .

#### Subjects

The subjects for the experiment consisted of five groups of business managers from 53 different firms in the U.S., Canada, and Europe (West Germany and the Netherlands). Table 1 provides a summary of the different groups. In total, 237 managers participated in the experiment. These managers had experience levels in the range of 5-35 years and held management positions ranging from junior to very senior levels. Approximately one-half of the managers in group 5 had a title of vice president or above.

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Place Table 1 About Here

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Groups 1 and 2 were comprised of managers from the telecommunications industry in the U.S. and Canada, while the remaining groups consisted of managers from a broad cross section of industry in the U.S. and Europe. The latter groups included managers from firms in manufacturing, research and development, mining, consulting, retail food chains, airlines, banking and insurance.

#### Experimental Conditions

Two significant differences existed in the experimental conditions for the various groups: (1) the context of the decision making process used to measure  $\alpha$  and (2) the scale of outcomes associated with the alternatives. A summary of the experimental conditions is presented in Table 1.

A difference in the context of the decision making process was created by advance instructions provided to the managers. In three of the groups (1,3 & 4), managers were asked to choose between alternatives as if they were making personal decisions, i.e., investing their own money in the chosen alternatives as well as receiving the profits and losses from them. In the remaining two groups (2&5), managers were asked to make decisions about alternatives as if they were doing so in a managerial capacity on behalf of their company, i.e., investing company resources in the chosen alternatives with the resulting profits and losses accruing to the company. The two groups with the managerial context were also provided advance instructions to indicate that the quality of their decisions would be

evaluated, ex post, on the basis of the total value of profit that their chosen alternatives generated for the company during the experiment.

The second major difference between groups was the scale of outcomes associated with the alternatives presented to the managers. As shown in Table 1, values of  $\alpha$  were estimated for two values of  $d$  ( $d = \$10, \$20$ ) for groups 1 and 4 and for three values of  $d$  ( $d = \$10, \$20, \$100$ ) for groups 2, 3, and 5. The scale factor shown in Table 1 indicates the amount by which  $d$  was multiplied when alternatives were generated for each group. For those groups having a personal decision context, the scale factor was 1, so that outcomes were not scaled upward. This was done to place the size of outcomes in the range that is likely to be significant when associated with personal decision making for relatively small stakes, while simultaneously avoiding alternatives with large losses. With  $d = \$20$ , for example, the initial decision presented to these groups was a choice between a risky alternative promising an outcome of  $-\$40$  with probability .5 and an outcome of  $\$0$  with probability .5, denoted  $(-\$40, .5; \$0, .5)$ , or a surething alternative promising  $-\$20$ .

The scale factors used for the groups having a managerial context were selected to create magnitudes of outcomes compatible with those involved in business decisions. The scale factors were 1,000 for group 2 and 100,000 for group 5. With these scale factors and  $d = \$20$ , for example, the initial risky alternatives presented to groups 2 and 5 were  $(-\$40,000, .5; \$0, .5)$  and  $(-\$4,000,000, .5; \$0, .5)$  respectively. This difference in the size of the scale factor between groups 2 and 5 created a medium stake situation for group 2 and a large stake situation for group 5. However,

with one exception to be discussed below, executives in both groups were asked in advance of the experiment to assume that any losses incurred because of their decisions would reduce the total profit of their company, and their evaluation, but would not impair the company's financial viability.

The exception occurred for group 5. Executives in this group were informed that a loss of \$20,000,000 for any one alternative would lead to severe liquidity problems for their firms, and possibly bankruptcy, so that a loss of this magnitude was tantamount to a ruinous loss. Given a scale factor of 100,000 for this group, a value of  $d=\$100$  resulted in an initial alternative that had the ruinous loss outcome. This situation was created in order to investigate the impact of a ruinous loss ( $d=\$100$ ) on  $\alpha$ , relative to  $\alpha$  values for losses that do not impact on financial viability ( $d=\$10, \$20$ ).

For all groups, it was assumed that the target return appropriate for defining gains and losses was the status quo, i.e., the reference point of no gain or no loss, and that  $t=0$ . This assumption has been frequently used in previous research dealing with risk attitudes, even though it is recognized that the target return can be higher or lower than status quo in some circumstances [4], [14]. The rationale for using  $t=0$  in the present study is that status quo is a natural reference point in risky decision situations since it represents the return that could be earned with certainty if all risky alternatives were to be rejected. The natural reference point was considered directly appropriate for the groups of executives who were asked to make decisions in a personal context. For those groups that were

asked to make decisions in a managerial context, the relevance of the natural reference point was reinforced by advance instructions. Executives in these groups were told that a zero return would be used to evaluate the quality of decisions they made, with an outcome above (below) zero being considered favorable (unfavorable).

All executives were asked to consider each pair of alternatives as separate decision problems and were informed that they could take all of the time necessary to evaluate the alternatives before making a choice. In addition, all executives were told that there were no correct answers to the decisions they were asked to make, in any absolute sense, and that the best alternative in each case was the one that best matched their preferences. The ordering of alternatives for each value of  $d$  within a group and the right-left positions of the alternatives on the screen of the computer terminal were randomized.

#### RESULTS

Of the 237 managers who participated in the experiment, 224 provided responses sufficient to allow an estimate of  $\alpha$  for all values of  $d$  appropriate for their group. A summary of the observed values of  $\alpha$  is provided in Table 2 for all groups and all values of  $d$ , with the exception of  $\alpha$  for

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Place Table 2 About Here

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$d = \$100$  for group 5.<sup>2</sup> Analysis and discussion of this set of  $\alpha$  values -- which reflect ruinous loss considerations -- is deferred to a later section. Table 2 shows a count for each group of the number of  $\alpha$  values in the risk seeking range ( $\alpha < 1$ ) and in the risk aversion range ( $\alpha > 1$ ). This count



indicates that a large majority of the managers in each group exhibited risk seeking behavior for below target returns. Over all groups, 400 out of the 521 values of  $\alpha$  (or 77%) were in the risk seeking range. At the individual manager level, the measured  $\alpha$  values exhibited some variation in magnitude for different values of  $d$ , as only 12 out of the 224 managers had  $\alpha$  values that remained exactly the same (to four decimal places) for all values of  $d$ . However, 165 (or 74%) of the managers had  $\alpha$  values that were consistently in the risk seeking range or consistently in the risk aversion range for all values of  $d$ . Summary data for just those managers, by group, are also provided in Table 2. Data for those managers who were consistent also strongly indicate the predominance of risk seeking behavior for below target returns. Out of the total of 165 managers who provided consistent signals about risk preference, 138 (or 85%) were consistently risk seeking.

As identified by Fishburn [4, p.120], a critical assumption in the procedure used to estimate  $\alpha$  is that it is not dependent upon the value of  $d$  used to generate alternatives for presentation to the managers. The value of  $d$  is designed to play the role of a significant difference from the target return and to determine the range of outcomes for the alternatives, but otherwise is arbitrary. The variation in  $\alpha$  values for most managers, noted above, raises the suspicion that this assumption was violated. To formally test the hypothesis that the observed values of  $\alpha$  were not dependent upon  $d$ , a two-tailed significance test was used for each group of managers -- the Wilcoxon signed rank test [17] for those groups having two values of  $d$  (groups 1,4,65) and the Friedman aligned ranks test [17] for

those groups having three values of  $d$  (groups 2&3). Both of these tests are based on a ranking of the differences between the  $\alpha$  values for each manager over all relevant values of  $d$ . Results of these tests are summarized in Table 2. The null hypothesis of no difference is acceptable for all groups using a significance level of .01. For four of the groups, the hypothesis is acceptable even if the significance level, denoted by  $p$  in Table 2, were to become quite large, i.e., ranging from .86 for group 2 to .97 for group 4. For group 5, the hypothesis is barely acceptable. Collectively, these results support the assumption that the observed variations in  $\alpha$  values were due to chance factors associated with the measurement process and were not due to variations in  $d$ .<sup>3</sup>

Given the lack of dependence of  $\alpha$  on  $d$ , the observed values of  $d$  were averaged for each manager, with the average value of  $\alpha$  used as a summary indicator of risk preference for below target returns. The resulting average values of  $\alpha$  are shown in Table 3 in the form of a frequency distribution for each group. These frequency distributions also strongly support the predominance of risk seeking behavior for below target returns.

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Place Table 3 About Here

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For all groups, the majority of managers had average  $\alpha$  values in the risk seeking range. The magnitude of the majority ranged from a high of 83% for groups 1 and 3 to a low of 55% for group 5.

The general form for the frequency distributions for the five groups are similar, even though group 5 had a larger percentage of managers in the

risk aversion range compared to the other groups. To formally test whether the average  $\alpha$  value of a manager was dependent upon group membership, a Kruskal-Wallis test [17] was employed. The null hypothesis is that there is no difference in the distribution of average  $\alpha$  values across the five groups. The relevant statistic for the test ( $H=6.7$ ) indicates that the null hypothesis is acceptable even if the significance level  $p$  were as high as .15. This result provides support for the proposition that the distribution of risk preferences for below target returns tended to be stable over the rather wide range of experimental conditions used in this study. The different groups were comprised of a diverse set of managers in terms of experience, industry type, and country. In addition, there were differences in the context of the decision process used to measure  $\alpha$  (personal versus managerial) and the size of outcomes below target (small, medium, and large stakes). None of these differences influenced the distribution of average  $\alpha$  values to such an extent that the distribution of risk preferences across groups of managers was altered.

Table 3 also shows the aggregate distribution of risk preferences over all 5 groups. On an aggregate basis, 158 out of 224 managers (or 71%) had risk preferences for below target returns that were in the risk seeking range. This finding is similar to that reported by Fishburn and Kochenberger [5]. In a study of 28 managers, using a different methodology, these authors found that two-thirds had utility functions that were convex or risk seeking for below target returns.

The Impact of Ruinous Loss

For group 5,  $d=\$100$  resulted in alternatives that had ruinous losses associated with them. Under this circumstance, it is reasonable to expect that managers would provide responses that imply an increased value of  $\alpha$  relative to the average value of  $\alpha$  for non-ruinous losses ( $d=\$10, \$20$ ). Faced with the possibility of ruinous loss, managers are likely to become less risk seeking and may even revert to risk averse behavior. Data from the present study supports this expectation. For 59 out of the 75 managers,  $\alpha$  values for the ruinous loss situation ( $d=\$100$ ) were larger than their average value of  $\alpha$  for non-ruinous losses. A formal test of the impact of a ruinous loss on risk preference was made using a one-sided Wilcoxon signed rank test [17]. The null hypothesis for this test was that the value of  $\alpha$  is unaffected by the existence of a ruinous loss outcome, while the alternate hypothesis was that  $\alpha$  increases when the possibility of a ruinous loss exists. Test results ( $z=-5.29, p=0$ ) indicate that the null hypothesis is rejected, since there is almost no chance of the observed value of  $z$  if the null hypothesis were true. There is therefore strong evidence that the risk preference of managers for below target returns becomes less risk seeking when ruinous loss outcomes are involved.

Another way of summarizing the impact of a ruinous loss on risk preference is to count the number of managers who remained either risk seeking or risk averse, for both ruinous and non-ruinous loss situations, and the number of managers for whom the change in risk attitude due to the possibility of ruinous loss was of a sufficient magnitude to result in a switch from risk seeking to risk aversion, or the reverse. The impact of ruinous loss considerations on risk preference is reinforced by such a count.

When ruinous loss was not a possibility, the majority of managers (41 out of 75) had a value of  $\alpha < 1$ . On the other hand, when ruinous loss was a possibility the majority of managers (48 out of 75) had a value of  $\alpha > 1$ . A test of the within subjects shift in risk preference showed a significant switch from risk seeking to risk aversion ( $\chi^2 = 7.0, p < .01$ ).

#### Individual Differences

The results from the present study, and those of most other studies of decision making under risk, indicate the presence of large individual differences in risky decision behavior. In order to explore possible correlates of such individual differences, several demographic characteristics were recorded prior to the assessment of values for the 75 managers in group 5. The demographic characteristics are summarized in Table 4. For firm type, the "other" category consists of several firms that had only one or two managers participating in the experiment. Organizational level for a manager was recorded as senior if the manager was vice president or above, and as junior, if below. Two sets of linear regression models were investigated, one using the average value of  $\alpha$  for  $d=\$10$  and  $d=\$20$ , denoted  $\alpha_{avg}$  as the dependent variable and one using the value of  $\alpha$  for the ruinous loss situation denoted  $\alpha_{100}$ , as the dependent variable. Estimation of the model employed stepwise, least squares procedures. With the exception of age, all of the demographic characteristics were represented by dummy variables, using the reference group for each category as shown in Table 4.

A summary of the best fitting regression models for both dependent variables is provided in Table 4. For the non-ruinous loss situation,

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Insert Table 4 About Here

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country is the most significant demographic characteristic ( $p=.05$ ). The regression coefficient for country (.6323) indicates that managers from the Netherlands have substantially larger  $\alpha$  values and, therefore, tend to place more emphasis on the magnitude of below target returns than do their German counterparts. Organizational level is also significantly associated with  $\alpha_{avg}$  ( $p=.10$ ), and has a regression coefficient (.3637), suggesting that senior managers are relatively more concerned with the magnitude of below target returns than are junior level managers. Only one of the firm variables proved significant ( $p=.10$ ) as managers from airlines tended to have values of  $\alpha_{avg}$  substantially lower than those for other firms. There is no statistically significant association between  $\alpha_{avg}$  and years with firm, education level, or education type.

Regression results for the ruinous loss situation are similar to those for  $\alpha_{avg}$  in some respects. Country and organizational level are again highly significant ( $p=.01$ ) with the regression coefficients having the same sign as they did for  $\alpha_{avg}$ . However, in the case of ruinous loss, the size of regression coefficients for both country and organization level are substantially larger in magnitude than they were for non-ruinous losses, indicating that these two variables have a more substantial impact on risk preference when ruinous losses exist. The major difference between regression results for the ruinous and non-ruinous loss situations is the larger number of significant firm effects for ruinous losses. Four of the

firm variables are significant in this case, with each coefficient being substantial in magnitude and negative. Years with firm, educational level and education type, are again not significantly associated with risk preference.

#### SUMMARY AND IMPLICATIONS

This study has provided empirical evidence about risk preference for below target returns for a large and diverse group of business managers. The methodology employed was based on some of the ideas dealing with downside risk derived from Fishburn's  $\alpha$ - $t$  model. The results strongly support the existence of risk seeking behavior for below target returns, when only non-ruinous losses are involved. On an overall basis, 71% of the managers in the study exhibited this form of behavior. Furthermore, the observed pattern of risk preference for below target returns was not significantly altered by the diversity of background of the different business managers, by the context of the decision making process, or by the size of the losses involved. Ruinous loss, on the other hand, did tend to alter risk preference and increase the value of  $\alpha$ , indicating a reduction in the extent of risk seeking behavior for below target returns and, for a majority of managers, a switch to risk aversion. When ruinous loss considerations were introduced, 64% of the managers were risk averse; 44% of these same managers switched to risk seeking behavior when below target returns involved only non-ruinous losses. Regression analysis of measured risk preferences for both non-ruinous and ruinous loss situations indicate that country and organizational level are strongly associated with risk preference, while the importance of firm type is rather weak for non-ruinous loss situations and substantially more important when ruinous losses exist.

Two features of the study limit the generality of these conclusions with respect to the complete population of managers. First, a nonrandom sample of managers was used for the study. This raises some question about whether the results can be generalized beyond the sample. The results are consistent, however, with the study of a small group of managers previously reported by Fishburn and Kochenberger [5]. Second, the use of hypothetical choice behavior as the basis for assessing risk preference in the experimental procedure may not indicate how these same managers would behave in real choice situations. With these reservations in mind, the results do suggest the need for new positive models of risky choice behavior, such as that developed by Kahneman and Tversky [14], that allow for risk seeking for below target returns. Another possibility for a revision of positive models would be a modification of conventional cardinal utility theory to include a convex segment for below target returns.

The present results have implications for normative models as well as positive models. Models that are designed for implementation by firms in order to aid the decision process usually involve a trade-off between analytical tractability and descriptive reality of assumptions. The empirical evidence presented in this paper, in conjunction with the other studies cited, indicates that the literature based on risk aversion everywhere may have gone significantly too far in the trade-off of giving up descriptive reality in order to gain analytical tractability. It is essential that normative models reflect, as closely as possible, the risk preference of the decision maker or that implications of the model can be shown to be insensitive to improper assumptions. Without the necessary correspondence or insensitivity -- to the satisfaction of the relevant decision-maker -- normative models will simply be avoided, no matter how analytically tract-



able. Avoidance of formal models that explicitly incorporate risk dimensions is prevalent. Various papers (Frengen [6], Klammer [15], and Schall, et al. [21]) have reported on the limited use of models that explicitly incorporate risk into the decisionmaking process of firms. Firms apparently favor using relatively simple methods for handling risk, e.g., payback, adjustments to the discount rate, and sensitivity analysis, in spite of the fact that the literature contains a large number of analytical models that are designed to formally incorporate risk into the decision process. A variety of explanations can be provided for the reluctance of decision makers to implement formal risk models.

The empirical evidence reported in this paper would indicate that a major reason for lack of interest may be that the available models do not capture the essence of risk as defined by decision makers. When this occurs, it is not likely to matter how elegant or analytically tractable the model is. Analytical tractability ought to assume a secondary role in the development of normative models. A preferred approach would be to construct models based on a realistic assumption about risk preference and then to search for ways of obtaining solutions, even if solutions involve approximations. An approximate solution to a model that is based on a realistic risk preference assumption is more likely to be implemented than an exact solution to an analytically tractable model that is considered too contrived by the ultimate user.

TABLE 1

SUMMARY OF EXPERIMENTAL CONDITIONS

Group	Size	Values of d	Scale Factor	Context	Industry	Country
1	29(31) <sup>1</sup>	\$10, \$20	1	Personal Manager	Telecommunications Telecommunications	U.S., Canada U.S., Canada
2	27(29)	\$10, \$20, \$100	1,000	Personal	Cross-section	U.S.
3	46(46)	\$10, \$20, \$100	1	Personal	Cross-section	U.S.
4	47(47)	\$10, \$20	1	Personal	Cross-section	U.S.
5	75(84)	\$10, \$20, \$100	100,000	Manager	Cross-section	Europe

The first number is the number of managers for which an estimate of  $\alpha$  was obtained for all values of d; the number in parentheses is the number of managers who tried the experiment.

TABLE 2  
SUMMARY OF RESULTS FOR ALL GROUPS

Group	Overall <sup>1</sup>		Consistent <sup>2</sup>		Test of Independence
	$\alpha < 1$	$\alpha > 1$	$\alpha < 1$	$\alpha > 1$	
1 (25) <sup>3</sup>	48	10	44	6	$z = .178, p = .87$
2 (18)	57	24	42	12	$\chi^2 = .331, p = .86$
3 (31)	118	20	90	3	$\chi^2 = 8.380, p = .015$
4 (42)	79	15	74	10	$z = -.040, p = .97$
5 (49)	98	52	70	28	$z = .122, p = .92$
Total	400	121	320	59	

<sup>1</sup>The number of  $\alpha$  values for each group observed in the indicated range for all values of  $d$ .

<sup>2</sup>The number of  $\alpha$  values in the indicated range for each group of managers who were consistently risk seeking or risk averse.

<sup>3</sup>The number in parentheses is the number of managers in each group who gave responses that were consistently risk seeking or consistently risk averse.

TABLE 3  
 DISTRIBUTION OF AVERAGE  $\alpha$  VALUES  
 FOR EACH GROUP

Range of $\alpha$	Group					Combined
	1	2	3	4	5	
0 - .25	5	8	13	13	16	55
.25 - .50	11	6	10	16	15	58
.50 - .75	5	1	9	7	6	28
.75 - 1.00	3	2	6	2	4	17
1.00 - 1.25	0	0	0	1	6	7
1.25 - 1.50	0	3	4	0	3	10
1.50 - 1.75	0	0	2	0	3	5
1.75 - 2.00	1	0	0	2	8	11
2.00 - 2.25	1	1	0	0	8	10
2.25 - 2.50	1	2	1	0	2	6
2.50 - 2.75	1	2	0	2	1	6
2.75 - 3.00	1	0	0	0	0	1
3.00 - 3.25	0	1	0	0	1	2
3.25 - 3.50	0	0	0	0	0	0
3.50 - 3.75	0	1	1	4	2	8
<b>Risk Seekers</b>	<b>24</b>	<b>17</b>	<b>38</b>	<b>38</b>	<b>41</b>	<b>158</b>
<b>Risk Averters</b>	<b>5</b>	<b>10</b>	<b>8</b>	<b>9</b>	<b>34</b>	<b>66</b>

TABLE 4  
SUMMARY RESULTS OF REGRESSION ANALYSES

Independent Variable	$\alpha_{avg}$		$\alpha_{100}$	
	Coefficient	Standard Error	Coefficient	Standard Error
Country				
Germany*				
Netherlands	.6323***	.2891	1.3032****	.4996
Firm Type				
Bank			-1.0300***	.4761
Food Chain			-1.8140****	.5132
Chemical			-1.2350***	.5488
Airline	-.5066**	.2899	-1.9670****	.4997
Consulting				
Manufacturing				
Building			-1.4100***	.5539
Other*				
Organization Level				
Junior*				
Senior	.3637**	.2160	.8840****	.3127
Years with Firm				
Education Level				
High School*				
College				
Advanced Degree				
Education Type				
Technical				
Non-Technical*				
R <sup>2</sup>	.1024***		.3025****	

\*Denotes the variable excluded from the regression model as a reference group.  
 \*\*Significant at the 10% level.  
 \*\*\*Significant at the 5% level.  
 \*\*\*\*Significant at the 1% level.

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#### FOOTNOTES

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- <sup>1</sup> This view of outcomes as being coded as gains and losses relative to a target return is different from the conventional view of utility theory which defines outcomes on the basis of terminal wealth. See, for example, Kahneman and Tversky [14].
- <sup>2</sup> To conserve space, individual values of  $\alpha$  are not reported but will be provided upon request.
- <sup>3</sup> The stability test was also performed for just those managers who were consistently risk seeking or consistently risk averse. Statistical independence of  $\alpha$  to alternative values of  $d$  was also confirmed for these groups.