

How Do Investors Judge the Risk of Financial Items?

Lisa Koonce
Professor
University of Texas at Austin

Mary Lea McAnally
Associate Professor
Texas A&M University

Molly Mercer
Assistant Professor
Emory University

Please address all correspondence to:
Lisa Koonce
Department of Accounting
CBA 4M.202
University of Texas
Austin, TX 78712
(512) 471-5576
(512) 471-3904 (fax)
Lisa.Koonce@mcombs.utexas.edu

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How Do Investors Judge the Risk of Financial Items?

Abstract

This paper proposes and tests a new risk model that explains how investors perceive financial risks. The model combines conventional decision theory variables – probabilities and outcomes – with variables from psychology research by Slovic (1987). The latter includes variables such as the extent to which a risky item is new, causes worry, and is controllable. To test our model, we conduct two studies in which financial statement users judge the risk of a broad range of financial items. Our results indicate that both decision theory and Slovic variables are important in explaining investors' risk judgments. Further, we demonstrate that loss outcome information contained in mandated risk disclosures not only directly influences investors' risk judgments but also indirectly affects such judgments via its effect on select Slovic variables. These results provide new theoretical insights that should be useful to accounting and psychology researchers studying how people judge risk. Our results also imply that to fully understand the effects of current and future accounting risk disclosures, managers and regulators must consider the effects of these disclosures on decision theory *and* Slovic variables.

Keywords: Risk perception, risk disclosure, decision theory, psychology.

I. INTRODUCTION

Disclosure of information about risks and uncertainties has become an increasingly important part of financial reporting (Linsmeier and Pearson 1997). However, there is little empirical evidence on how financial statement users assess risk. Indeed, one prominent accounting researcher recently noted, “because most extant research focuses on effects of risk, not on how investors assess risk, the studies provide little explicit guidance about which disclosures can aid investors in assessing risk” (Schrand and Elliott 1998, 276). The purpose of this paper is to provide evidence on how financial statement users think about the risk of financial items and to determine how currently mandated risk disclosures affect risk perception.

Obtaining empirical evidence on this topic is of both theoretical and practical importance. From a theoretical perspective, the accounting literature on risk has focused on decision theory variables – probabilities and outcomes – when considering risk (Lipe 1998). However, research in psychology suggests that risk perceptions are a function of two factors, which Slovic (1987) labels dread and unknown. The extant literature generally has presumed that *either* the decision theory variables *or* the Slovic variables – but not both – describe people’s risk perceptions. In this study, we propose that the two sets of variables are complementary in that *both* are important in explaining investors’ risk perceptions. Further, we also propose that the two sets of variables are potentially causally related by arguing that the decision theory variables can influence how individuals think about select Slovic variables. By jointly considering the decision theory and Slovic variables, we provide new theoretical insights into how investors think about the risks of financial items and accounting risk disclosures.

On a practical level, evidence about how financial statement users perceive risk is relevant to both managers and regulators. Research in other domains has shown that people's risk *perceptions* directly influence their decision-making (Coombs 1975; March and Shapira 1987; Slovic and Weber 2002) and so understanding how financial statement users perceive risk is a necessary prerequisite for understanding their reactions to risk disclosures (Fischhoff 1995). Indeed, without knowledge about how financial statement users think about risk, it is difficult for regulators to discern whether risk disclosures are working as intended and for managers to design risk disclosures that assuage the worries of financial statement users. Regulators and managers can use our evidence regarding the factors underlying financial risk perceptions to craft more effective risk-related financial disclosures. Our insights are especially timely given the recent push for improved risk disclosures (Mayo and Rutschow 2002).

We conducted two studies to test our proposed model of perceived risk. In study 1, participants with significant work experience and business training read qualitative descriptions of 19 financial items of varying degrees of risk. Participants rated the overall riskiness of each item as well as a number of additional factors considered in the Slovic and decision theory risk models. Regression analysis of participants' responses revealed that the decision theory and Slovic variables *both* directly influenced investors' risk assessments, as hypothesized. Thus, a risk model that includes both decision theory and Slovic variables had greater explanatory power than models with either set of variables alone. Our study 1 results suggest that both sets of variables are needed to fully describe investors' risk judgments.

In study 2, we refined our model of investors' risk perception to capture the idea that not only do the decision theory and Slovic variables have direct effects on risk perception (as demonstrated in study 1), but also that the decision theory variables systematically affect the

Slovic variables. That is, study 2 investigated the previously untested idea that the decision theory variables (in particular, loss outcome information) cause investors to make inferences about select Slovic variables, which in turn, affect their risk perceptions. To test this new model, we drew on the insights obtained in study 1 and made two significant changes to the research design. First, we manipulated the level of a critical decision theory variable – loss outcome. Manipulating loss outcome not only allowed us to test the robustness of our study 1 results, but it also enabled us to test the validity of our new risk model. Second, study 2 used more-detailed, quantified risk disclosures about each financial item. In study 1, participants read brief descriptions of each financial item with qualitative descriptions of how loss and gain outcomes could occur. Such abbreviated and qualitative descriptions are not unusual, as popular press articles, management conference calls, and brokerage reports often describe risks related to financial items with little contextual detail (e.g., Buffett 2003; Fannie Mae 2003; Baker, *et al.* 2003). However, several professional standards require detailed and quantitative risk disclosures for financial items (i.e., FRR No. 48, SFAS Nos. 106 and 140). To ensure that financial statement users assess risk similarly in these situations, study 2 participants read sensitivity risk disclosures with quantified loss outcome information similar to those mandated under professional standards. This change also allowed us to test the generalizability of our study 1 findings.

The study 2 results strongly support our proposed model. Consistent with study 1, we found that both decision theory and Slovic variables directly influenced investors' risk judgments. Further, we observed that the quantified loss outcome information contained in sensitivity risk disclosures systematically influenced how financial statement users thought about select Slovic variables, which in turn influenced their risk judgments. From the

evidence provided in our two studies, we conclude that financial-risk perceptions are best described by a model that includes both decision theory and Slovic factors. Our conclusions hold regardless of whether the risks are being assessed in a relatively context-free environment (study 1) or in a more context-rich environment where decision theory (i.e., loss outcome) information is provided in a precise, quantified form (study 2).

Our results contribute to the existing literature in several ways. First, our findings add to the accounting literature that argues that risk is judged based on probabilities and outcomes. Specifically, we introduce new theoretical insights by demonstrating that financial statement users also consider other factors when judging risk, such as how much they worry about the risk, management's knowledge about the risk, and the extent to which the risk can be controlled. Our results show that knowing both sets of variables enhances our understanding of how individuals judge risk and is strictly better than knowing either set separately. By identifying this additional set of risk-related variables, our research has the potential to reshape the way accounting researchers, regulators, and managers think about risk perception.

Second, we provide important new theoretical insights to the psychological literature on risk. Consistent with prior studies, we demonstrate that the decision theory variables directly influence risk perceptions. However, we also show that the decision theory variables *indirectly* affect risk perceptions via their effects on the Slovic variables. These insights are new, not having been previously demonstrated in psychology or accounting and suggests that risk perception is more complex than prior risk models suggest. Thus, our study results, obtained using real-world financial risk disclosures, are important as both psychology and business scholars move forward in developing a more comprehensive theory of risk perception.

The paper is organized as follows. In the following section, we describe the decision theory and Slovic perspectives on risk. We also report the results of study 1 that examines the relative importance of the decision theory and Slovic variables in financial statement users' risk perceptions. The third section describes the results of study 2 that examines whether decision theory variables have indirect as well as direct effects on investors' risk perceptions and replicates our study 1 findings in a context-rich setting. The final section concludes and discusses implications of our results.

II. STUDY 1

Scholars do not agree on how people think about risk (Slovic and Weber 2002). Historically, there have been two dominant views on risk. The decision theory view proposes that risk judgments are based on probabilities and potential outcomes. That is, when assessing risk, people are presumed to assess the severity and likelihood of the possible outcomes. Empirical research supports this perspective (e.g., Weber 1988, Weber and Bottom 1989, 1990). Valuation models within accounting and finance also tend to take a decision-theory perspective, defining risk in terms of the variance of expected returns, cash flows, or earnings or the covariance of these measures with market factors (Froot, *et al.* 1993; Jorgensen and Kirschenheiter 2003). Perhaps because of this, the decision theory perspective is implicit in most risk-related accounting standards, which generally focus on disclosures of loss probabilities and/or loss outcomes (e.g., SOP No. 94-5, FRR No. 48, SFAS Nos. 5, 106, and 140).¹

In contrast, the behavioral perspective of risk argues that people do not think about risk in terms of probabilities and outcomes. Based on substantial research in the health and technology domains, Slovic (1987) suggests that people perceive risk based on their

assessments of two underlying dimensions, which he labels “dread” and “unknown.” Dread captures a risky item’s perceived controllability and voluntariness, as well as the amount of worry and catastrophic potential associated with the item. Unknown captures a risky item’s observability, its newness, the amount of knowledge about the item, and the immediacy of the item’s effects.

Prior studies tend to focus on *either* the Slovic variables *or* the decision theory variables when describing people’s risk judgments. In our first study, we challenge the presumption that the two perspectives are mutually exclusive and hypothesize that investors will rely on both types of information when judging risk (Lowenstein, *et al.* 2001). We predict that individuals judging the risk of financial items will consider the likelihood of potential positive and negative outcomes, as well as other more behavioral factors such as their degree of worry and controllability.

From a theoretical viewpoint, conceptual arguments have been made that most Slovic variables capture information above and beyond that in the decision theory variables. Perhaps with the exception of the catastrophic variable, the Slovic variables arguably capture different information than the decision theory variables (Holtgrave and Weber 1993). For example, unknown captures how well an item is understood, which is clearly different from the probability of a particular outcome from that item. That is, the probability of an event could be perceived to be very low, yet a decision maker could either have a low or high understanding of the event. Controllability represents whether actions could be taken to minimize an existing risk and not the likelihood of a particular risk or its magnitude. Whether outcomes from a risk occur immediately or over time is not captured by the magnitude of a risk nor its likelihood. Similarly, the newness of a risk is distinct from the probability of a

particular outcome or its magnitude. Thus, while Slovic variables are sometimes correlated with decision theory variables (i.e., high controllability may suggest low loss outcomes), the two sets of variables capture distinct information.

To test our hypothesis that the Slovic variables explain perceived risk above and beyond the decision theory variables, we estimate three risk models—one that includes only the typical probability and outcome variables considered by decision theory (hereafter, termed decision theory variables), one that includes only the dread and unknown variables often considered by psychologists (hereafter, termed Slovic variables), and a full model that includes both sets of variables.

To determine the most parsimonious and descriptive model, we compare the explanatory power of these three models. If our full-model R^2 is significantly greater than models containing either the decision-theory or Slovic variables only, we would conclude that *both* decision theory and Slovic variables are risk-relevant. (Kennedy 1998 184). We also compare the estimated coefficients of the three models. If either the decision theory or Slovic variables subsumes the other set, then the coefficient estimates on the subsumed set of variables will be insignificant in the full model. However, if one set of variables provides additional information over the other, then the additional variable coefficients will be significant in the full model.

This approach, where we compare the explanatory power of different models and the significance of the estimated coefficients, is common in accounting studies that analyze the incremental value-relevance of a particular set of variables (e.g., Lev and Thiagarajan 1993, Barth *et al.* 1996, Ittner and Larker 1998). Although most commonly seen in accounting studies using archival data, this method is equally valid with data collected from human

subjects (Byrne 2001). For example, when testing whether tacit knowledge is a determinant of managerial performance, Sternberg *et al.* (1995) estimated a series of regressions using knowledge, ability and performance measures obtained from individuals. Sternberg, *et al.*'s restricted model included a number of variables suggested by prior research, and their full model added the tacit knowledge measure as another explanatory variable. They found that the full model R^2 was significantly greater than the restricted model R^2 . Therefore, they concluded that the restricted set of variables did not subsume tacit knowledge (Sternberg *et al.* 1995 921).

Design and Procedures

Study 1 participants consisted of 40 graduate business students with approximately five years of work experience. Participants had taken an average of three finance and two accounting classes, and ninety-five percent had experience investing in common stocks. The study lasted approximately thirty minutes, and participants received \$10 upon its completion.

The study required each participant to evaluate nineteen financial items (see Panel A of Figure 1). Because our methodology necessitated meaningful variation in these evaluations to ensure interpretable results (cf. Holtgrave and Weber 1993), we purposely chose items so that some were likely to be perceived as low risk (e.g., cash), some as medium risk (e.g., employee stock options), and some as high risk (e.g., written call options). Research has shown that having multiple items to evaluate (i.e., making relative judgments) considerably improves the quality of judgments (Hsee, *et al.* 1999).

Insert Figure 1 here

To further ensure meaningful variation among the items, we provided a definition of each item as well as a brief qualitative description of how a loss outcome and a gain outcome could

occur.² Moreover, we asked participants to review a complete list of the items to be evaluated before making any individual assessments. Pilot testing and an examination of the participants' responses to the individual financial items indicated that this information allowed them to make meaningful distinctions among the items. That is, the assessments for the decision theory and Slovic variables were, on average, appropriately low or high for the nature of the item being evaluated. Thus, while we did not formally hypothesize differences in assessments among the 19 items, it appears that the response variation that they created was meaningful.

For each of the financial items, participants answered the questions shown in Figure 2. Eight questions measured the Slovic dimensions of dread and unknown. The questions asked participants to rate: (1) the extent to which they worried about the risks related to the item, (2) whether risks related to the item were likely to be catastrophic, (3) the degree to which management could control risks related to the item, (4) the extent to which the participant would voluntarily invest in a company with the financial item, (5) whether the risks related to the item were new or old, (6) the extent to which management understood the risks of the item, (7) the extent to which the participant understood the risks of the item, and (8) the degree to which item outcomes unfolded immediately or over time. Participants also assessed five decision theory questions. Specifically, participants rated the expected magnitude of any economic losses or economic gains, as well as the probabilities of an economic loss, an economic gain, and no change (i.e., status quo).³

Insert Figure 2 here

An additional question asked participants to rate the overall risk of the financial item. We did not provide study participants with a definition of "risk," as doing so would have defeated our objective in determining how investors think about risk. After rating all nineteen items,

participants also completed a post-experimental questionnaire that collected data on their coursework, investing experience, and work experience.

We undertook several procedures to ensure the validity of our results. First, we randomized the presentation of the 19 financial items so that all participants did not evaluate the items in the same sequence. Second, to ensure that the order of the questions did not lead participants to justify their Slovic and decision theory assessments with their risk judgments, we varied the order of the (1) Slovic versus decision theory questions, and (2) the risk question. (Due to the large number of questions and items, it was not possible to completely randomize question order.) Specifically, we asked the Slovic questions either before or after the decision theory questions, and asked the risk question either first or last in the sequence of all questions (i.e., four possible orders). None of the tests presented in the next section are systematically affected by question order. Third, we reversed the scale for four questions (i.e., voluntary, control, and the two knowledge questions). Thus, a “logical” response for any given item requires the participant to respond high on the scale for some questions and low on the scale for others, thereby precluding participants from merely responding in the same manner for all questions.⁴

Results

Table 1 provides descriptive statistics for the Slovic, decision theory, and overall risk questions. Panel A shows participants’ mean (standard deviation) judgments for each question averaged across the nineteen financial items, and Panel B presents correlations among the questions.

Insert Table 1 here

To determine what role, if any, the decision theory and Slovic variables play in participants' risk assessments, we estimate three models using ordinary least squares regressions. Specifically, we compare the explanatory power of a model containing just the decision theory variables (Model 1), a model containing just the Slovic variables (Model 2), and a model containing both sets of variables (Model 3).

Panel A of Table 2 reports our regression results. Because each participant rated all 19 items, we include participant-specific indicator variables to control for any non-independence among observations. This approach is consistent with empirical-archival methodology that estimates fixed-effects regressions with pooled (cross-sectional, time-series) data. Further, because tests reveal collinearity between the two knowledge questions (Belsley, *et al.* 1980), we estimate all regressions with the 'known by management' variable only. Results are similar if we include the 'known by participant' variable only.

Insert Table 2 here

Model 1 regresses perceived risk on the decision theory variables. As expected, loss probability and loss outcome have significant positive coefficients, suggesting that greater loss outcomes and probabilities increase perceived risk. Moreover, the estimated coefficients on gain probability and gain outcomes are both positive, although the probability of gain measure is not statistically significant. A positive coefficient on gain outcome suggests that participants believed that greater gains lead to greater risk. Interestingly, the coefficients on both loss variables are significantly greater than those on their gain counterparts ($F > 7.5$, $p < 0.01$ for both). Thus, while gains and losses both increase risk perceptions, participants

believe risk increases more for a potential dollar lost than for a dollar gained (Weber and Bottom, 1989, 1990).

Model 2 regresses perceived risk on the Slovic variables. Many of the variables comprising the dread and unknown dimensions of risk are significant determinants of participants' risk perceptions. Specifically, the worry, voluntary, known by management, control and catastrophic potential variables are statistically significant, while the newness and immediacy variables are not significant. Consistent with prior research, we find a positive relation between perceived risk and the worry and catastrophic potential variables and a negative relation between perceived risk and the known, control, and voluntary variables. That is, participants perceived more risk when they worried about an item or when its catastrophic potential was greater and perceived less risk when the risk was known by management, when the risk was more controllable or voluntary.⁵

In Model 3, we regress perceived risk on both the decision theory and Slovic variables, providing a critical test of the incremental importance of these latter variables. We find that the decision theory variables that were significant in Model 1 (i.e., loss probability, loss outcome, and gain outcome) remain significant in Model 3. The Slovic variables that were significant in Model 2 (worry, catastrophic potential, known, control, and voluntary) also remain significant in Model 3. The fact that both sets of variables remain significant even after including the other set suggests that neither set of variables subsumes the other.⁶

Finally, nested *F*-tests reveal that Model 3 has significantly more explanatory power (adjusted for the number of variables in the model) than either Models 1 or 2 ($F > 15.0$, $p < 0.01$ for both), again suggesting the relevance of the Slovic variables. Our results lend credence to the idea that Slovic variables capture new risk-related information and that

investors' risk judgments can be better understood by considering both Slovic and decision theory variables.⁷

Robustness Checks

To ensure that our results are not sensitive to our study procedures, we conducted several robustness checks. One potential concern is that a subset of participants merely justified their risk assessments with their decision theory and Slovic assessments (or vice versa), thereby leading to the observed correlations in our Table 2 results. As discussed previously, we made several design choices to ensure that this did not occur, such as varying the question order and reversing the question scales. To provide additional assurance, though, we re-estimated Models 1, 2 and 3 excluding participants whose responses suggested that they might have engaged in justification behavior. Specifically, we excluded observations where the dependent variable and any one decision theory or Slovic variable was identical. We also excluded observations where the dependent variable was identical to the loss outcome, probability of loss, and worry variables (i.e., the most influential variables in our regressions). The regression results from these re-estimations are similar to those reported in Table 2. Thus, we conclude that if our study participants engaged in justification behavior, it was not systematic enough to influence our regression results.⁸

We also address the possibility that influential observations drive our results by re-estimating our models on distinct sub-samples. We deleted the highest and lowest five percent of observations for each variable in turn (i.e. we include the middle 90 percent of the observations). We also deleted the highest and lowest one percent of observations for all the variables simultaneously. The results from these re-estimations are inferentially the same as those in Table 2, suggesting that our results are not driven by extreme observations.

Finally, to address the potential concern that the catastrophic variable might be more aptly included with the decision theory rather than with the Slovic variables, we re-estimated Model 1 with the catastrophic variable and re-estimated Model 2 without it. These tests reveal that our inferences about the relative explanatory power and significant coefficients of the Slovic and decision theory variables do not change from those presented in Table 2. Consequently, even if catastrophic potential is better classified as a decision theory variable, the other Slovic variables remain significant and the full model better explains investors' risk perceptions.

In sum, our study 1 results strongly support our conjecture that *both* decision theory and Slovic variables underlie investors' risk perceptions. That is, financial risk perceptions are influenced not only by probabilities and outcomes, but also by other factors such as how much individuals worry about the risk, the extent to which the risk can be controlled, and whether the risk is known to management. These results are significant, as they suggest that investors' risk judgments are significantly more complex than prior accounting risk models suggest.

III. STUDY 2

Study 2 extends study 1 in several important ways. First, study 2 examines the relative roles of the Slovic and decision theory variables using more detailed risk disclosures. Low-context, qualitative disclosures such as those used in study 1 are not uncommon; investors receive brief descriptions of financial items from sources such as popular press articles, conference calls, and brokerage reports (e.g., Buffett 2003; Fannie Mae 2003; Baker *et al.* 2003). However, mandated risk disclosures (e.g., FRR No. 48, SFAS Nos. 106 and 140) require a greater level of contextual detail, including quantified information about potential losses. To ensure that our study 1 results generalize to these types of settings, we asked study

2 participants to judge the risk of financial items within the context of detailed, quantified risk disclosures similar to those currently mandated by professional standards.

Second, we manipulate a key decision theory variable found in mandated risk disclosures – potential loss outcome. It is possible that our study 1 participants were not able to precisely assess the decision theory variables, thus leading to an artificially high reliance on the Slovic variables in that study. In study 2, we quantify the potential loss outcome, which should enable participants to make highly informed judgments about this key decision theory variable. In other words, we give participants the opportunity to rely solely on quantitatively precise information and, therefore, minimize the likelihood that the Slovic measures are significant in study 2.

Manipulating this key decision theory variable also allows us to examine the previously untested hypothesis that decision theory and Slovic variables are interrelated. That is, in study 1, we tested the idea that decision theory and Slovic variables both have direct effects on investors' risk judgments. In study 2, we argue that not only will decision theory and Slovic variables have direct effects on risk perception (as demonstrated in study 1), but that the decision theory variables will have systematic effects on select Slovic variables which will, in turn, influence risk judgments. The idea that the decision theory and Slovic variables may be interrelated has been recently conjectured (Lowenstein, *et al.*, 2001) but, to date, no one has specified the relation between these variables nor have they empirically tested this idea.

We hypothesize that the decision theory variable (loss outcome) will influence investors' perceptions of dread but not unknown. Prior research in the insurance domain suggests that loss outcome information may influence perceptions of dread. For example, Kunreuther, *et*

al. (1978) find that individuals are more likely to purchase flood or earthquake insurance after experiencing a flood or earthquake. They argue that this effect occurs because potential losses are more vivid and, thus, worrisome for those who have recently experienced such a loss. Drawing on this idea, we argue that potential losses associated with a financial item should influence the dread associated with that item which, in turn, will influence risk perceptions. In contrast, it seems unlikely that variations in potential loss outcomes will influence Slovic's unknown dimension. That is, variation in losses should not systematically affect, for example, the perceived degree of knowledge about an item. Thus, we posit that loss outcome will be positively related to the Slovic dread dimension, but have no effect on the Slovic unknown dimension of risk.

Design and Procedures

Study 2 participants consisted of one hundred graduate business students with demographics similar to those participating in study 1. The study lasted approximately thirty minutes, and participants received \$10 upon its completion. Each participant evaluated the six financial items shown in Panel B of Figure 1.⁹ Similar to study 1, these items were selected to vary in overall riskiness, and we randomized the presentation order of the items to minimize order effects. For each financial item, participants received a detailed risk disclosure based on actual mandated risk disclosures found in 10-K reports. Specifically, each disclosure described the loss outcome consequences of a hypothetical ten percent change in market rates similar to the sensitivity disclosures mandated under FRR No. 48 and SFAS Nos. 106 and 140. Within each risk disclosure, we varied the level of an important decision theory variable – potential loss outcome. We manipulated this variable at two levels on a between-subjects basis. Specifically, we informed participants in the low [high] loss outcome

condition that a ten percent change in market conditions would cause an economic loss to the company in the amount of approximately 1 percent [40 percent] of the company's equity.

After reviewing each risk disclosure, participants answered the same set of risk questions used in study 1 (see Figure 2).¹⁰

Results

Manipulation Checks

Two checks of our loss outcome manipulation indicate that it was successful. In the post-experimental questionnaire, we asked participants to assume that two otherwise identical companies reported the same market risk disclosures, with one company reporting a potential loss equaling 1 percent of equity, and the other reporting a potential loss equaling 40 percent of equity. For each company, participants indicated the materiality of each of the potential losses on a 101-point scale with 0 designated "completely immaterial" and 100 designated "completely material." The mean materiality assessment is 33.11 for the low loss outcome and 83.71 for the high loss outcome, indicating a successful manipulation ($t = 15.51, p < 0.01$).

As an additional check, we analyzed participants' responses to the loss outcome question.

Table 1 shows the mean anticipated loss in the low loss condition ($\mu = 35.8$) is significantly lower than the mean anticipated loss in the high loss condition ($\mu = 43.9, t = 3.02, p < 0.01$), providing further evidence that our manipulation was successful.

Replicating Study 1 with Real-World Risk Disclosures and Loss Manipulation

Before we tested the idea that the decision theory and Slovic variables are interrelated, we first determined whether our study 1 findings replicate with more-detailed, quantified risk disclosures and the loss-outcome manipulation. Specifically, we performed two sets of regression analyses similar to those in study 1 – one with the *measured* Slovic and decision

theory variables as independent variables, the other with the *manipulated* decision theory variable in place of the measured variables.

Panel B of Table 2 provides regression results for models that include the measured variables. Consistent with study 1, loss probability and loss and gain outcomes have significant positive coefficients in Model 1, suggesting that greater outcomes and probabilities lead to greater perceived risk. Whereas the probability of gain and status quo measures were insignificant in study 1, study 2 shows significant negative coefficients for both variables. Thus, as the probability of a gain or status quo outcome increases, perceived risk decreases. Model 2 regresses perceived risk on the Slovic variables. Once again, results are similar to those from study 1. In Model 3, the variables that are significant in Models 1 and 2 remain significant, with the exception of the gain probability variable. Nested *F*-tests reveal that Model 3 has significantly more explanatory power than either Model 1 or Model 2 (both F 's > 6.0, both p -values < 0.01). Thus, as in study 1, a model that includes both the Slovic and decision theory variables best describes investors' risk perceptions.¹¹

Our second set of regressions replaced the measured loss variable with the manipulated loss outcome variable, a binary variable that indicated the participants' loss condition. Our results revealed very similar results to those presented above. That is, the loss outcome manipulation was statistically significant in Model 1, suggesting higher potential loss outcome leads to greater risk ($t = 2.69, p < 0.01$). More importantly, the Slovic variables continued to contribute significantly to the model's R^2 and we conclude that Model 3 still provides the highest explanatory power.

Similar to study 1, we conducted various robustness tests. First, we estimated models 1 and 3 with only the manipulated loss variable—that is, without loss probability, gain

probability, status quo probability, and gain outcome. Second, we excluded extreme observations and observations that suggested potential justification behavior. Third, we re-estimated Model 1 including the catastrophic variable and Model 3 excluding it. Inferences about relative explanatory power of the decision theory and Slovic variables do not change under any of these conditions.

In sum, our study 2 regression results are robust and consistent with those from study 1. That is, regardless of whether investors assess risk in a relatively context-free environment (such as that used in study 1) or in a context-rich environment (such as that used in study 2), their risk perceptions are best explained by a model that includes both decision theory and Slovic variables.

Testing the Interrelationship between Decision Theory and Slovic Variables

We also designed study 2 to test our hypothesis that the decision theory variables have indirect, as well as direct, effects on investors' risk judgments. Recall that we predict that when investors read risk disclosures that include information about potential loss outcomes, this information will affect their inferences about the Slovic dread dimension, and these dread perceptions, in turn, will influence their risk judgments. To test this idea, we use structural equation modeling (Byrne 2001). This technique has been used previously in accounting studies (e.g., Libby and Tan 1994, Phillips 1999, Towry 2003) and is a widely accepted method for simultaneously testing the direct and indirect effects of manipulated variables on a dependent measure.

Figure 3 depicts our model. Perceived risk corresponds to our overall risk measure. Manipulated potential loss outcome corresponds to our manipulation, and the Slovic factors correspond to the dread and unknown dimensions (see discussion below). To conclude that

potential loss outcome has both direct and indirect (via the Slovic variables) effects on risk, we must show two results with our structural equation analysis. First, we must show that the link from the manipulated variable, potential loss outcome, to perceived risk (Link 1) is significant. Second, we must show that the links from the manipulated loss outcome to dread (Link 2) and from dread to perceived risk (Link 3) are statistically significant, while the link from the manipulated loss outcome to unknown (Link 2) is not significant. Further, we must find that Link 1 remains significant once we introduce Links 2 and 3. If Link 1 becomes insignificant when we include Link 2, we would conclude that the Slovic variables are substitute measures of the same construct as loss outcome. If, however, Link 1 retains its significance and Links 2 and 3 also are significant, our hypothesized model would be supported and we would conclude that the decision theory variable (i.e., loss outcome) has a direct effect on risk and also an indirect effect on risk via its influence on Slovic's dread variable.

Insert Figure 3 here

Our model is new to the accounting and psychology literatures. While Link 1 by itself represents the decision theory perspective traditionally considered in accounting, Links 2 and Link 3 incorporate the Slovic perspective that has not been previously considered in accounting. Further, Link 2 is new to psychology; no prior study has examined a possible causal relationship between decision theory and Slovic variables. Thus, evidence on this relationship should contribute not only to the field of accounting but also to base disciplines such as psychology and economics.¹²

To parsimoniously conduct our tests, we first reduce the number of Slovic variables by conducting a factor analysis on participants' responses to the eight Slovic questions.¹³ Table

3 shows that two factors emerge, largely consistent with Slovic (1987). Specifically, our first factor, which we label dread, comprises worry, catastrophic, voluntary, immediacy, and new. The second factor contains the two known questions as well as the control question, and is designated as unknown.¹⁴ Because it is not econometrically possible to incorporate the repeated measures nature of our study (i.e., participants completed six cases) with existing structural equation software, we average participants' responses to the six items and use one summary measure in our analyses.¹⁵

Insert Table 3 here

Our structural equation analysis simultaneously estimates two models. The first model, which is consistent with the decision theory perspective, includes only Link 1. As one would expect, we find a strong positive coefficient for Link 1 in the first model, consistent with the notion that as loss potential increases, perceived risk increases ($t = 2.76, p < 0.01$, not tabulated). The second model includes Links 1, 2, and 3, as shown in Figure 3. If our hypothesis is correct – that decision theory variables have indirect, as well as direct, effects on risk perceptions – this second model should fit the data significantly better than the first model and the individual links should exhibit the expected relationships described earlier. Nested model comparisons show that, consistent with our predictions, the fit of the second model is significantly better than the fit of the first model ($\chi^2 = 48.39, p < 0.01$). The Comparative Fit Index for the second model shows a fit of 99.1%, which is well above the accepted cutoff value of 95% (Byrne 2001). In contrast, the fit of the first model is only 87.7%, which suggests an unacceptable fit.

Given the better fit of our hypothesized model, we next examine specific estimated path coefficients. As expected, Link 1 is positive and significant ($t = 2.20, p = 0.01$), suggesting that as loss potential increases so does perceived risk. Link 3 is significant for both Slovic factors (both p -values < 0.01). These results indicate that items creating more dread result in greater perceived risk, as do those that are more unknown. (See Table 1 for the means and corresponding t -tests for the Slovic and unknown questions.) Most importantly, Link 2 is highly significant for the dread dimension ($t = 1.95, p = 0.03$), but is not significant for the unknown dimension ($t = 0.78, p = 0.44$). In sum, these results strongly support our conjecture that the decision theory variable of loss outcome directly affects risk judgments and that it also indirectly effects risk via its effect on the Slovic dread dimension.

These results also bolster our previous argument that the Slovic variables are not redundant with the decision theory variables. If dread and loss outcome were redundant, the results of this analysis would show a statistically significant Link 1 and an insignificant Link 2 (Byrne 2001). In other words, if the dread dimension captures the same underlying information as the loss outcome variable, it is not econometrically possible for *both* Links 1 and 2 to be significant in our structural equation analyses. Because both Links 1 and 2 are significant in our model, we conclude that both are capturing unique information regarding investors' risk judgments.

Taken together, these study 2 results suggest risk disclosures containing information about potential loss outcomes have both direct effects on perceived risk and indirect effects on perceived risk via their influence on dread. By showing that measures of constructs that should be related to each other are, in fact, related to each other (i.e., that potential loss outcome influences perceived dread) and that measures of constructs that theoretically should

not be related to each other are, in fact, not related to each other (i.e., that potential loss outcome does not influence perceived unknown), we provide evidence of both convergent and discriminant validity in our study 2 (Trochim 2001). Thus, we believe that our model provides valid new insights into how individuals judge financial risks.

IV. IMPLICATIONS AND CONCLUSIONS

This paper describes two studies that provide descriptive evidence on how financial statement users judge the risk of financial items. The results of these studies challenge the idea that risk perceptions are described solely in terms of traditional decision theory factors (i.e., probabilities and outcomes). By drawing on theoretical insights about risk from psychology research by Slovic (1987), we identify and test additional variables that could potentially describe financial statement users' risk perceptions. We find that a risk model that incorporates these Slovic variables factors provides significant incremental explanatory power over a model containing only decision theory variables. By documenting the significant role that these factors play in determining reactions to accounting risk disclosures, our study adds to the existing accounting theory about how risk is judged.

We also empirically document that these decision theory and Slovic variables are not independent in their effects on perceived risk. That is, we show that potential loss outcome has an indirect, as well as a direct, effect on risk perceptions. As one would expect, higher potential loss outcomes lead to greater perceived risk. Interestingly, though, we also find that potential loss outcome has an indirect effect on perceived risk via its influence on dread. Specifically, higher potential loss outcome leads to greater dread, and greater dread, in turn, leads to greater perceived risk. This result is novel as no prior study in accounting, finance, psychology, or any other field has empirically established a causal relation between decision

theory and Slovic risk factors. This result not only theoretically contributes to the accounting literature but also the existing psychology theory on risk perception.

Our results also have practical implications. Regulators in other domains (e.g., nuclear power, AIDS, smoking) have found that it is often easier to tailor risk disclosures to users' understanding of risk than it is to re-train individuals to think differently about risk (Fischhoff, *et al.* 1981; Fischhoff 1995). However, in order to take this approach, regulators must first understand the factors that people consider when judging risks. As Schrand and Elliott (1998) note, there is virtually no empirical evidence on how investors react to risk disclosures. This dearth of descriptive evidence makes it difficult for regulators as they grapple with the best way to disclose risk-related information. Our findings should be useful in this regard, as they provide much-needed descriptive evidence on the factors that investors consider when judging the risks of financial items.

Our findings suggest several productive avenues for future research. In particular, the significance of the Slovic variables point to a number of disclosure strategies firms might employ to influence users' risk judgments. For example, expanded disclosure of control policies and procedures (beyond the typical boilerplate discussions that currently exist) may reduce perceived risk via their favorable effects on perceived worry, management control, and knowledge. Thus, one worthwhile extension of our study would be to examine the effects of these types of expanded disclosures on users' overall risk perceptions.

Future research also may build on our findings by exploring the role that the Slovic variables play in investors' decision making and on market behavior. As our title indicates, the purpose of our study was to examine the factors that affect how investors judge the risk of financial items. Examining both judgments and decisions within the context of one study is

difficult, as collecting one of these sets of variables can easily confound the other set. Because we were primarily interested in identifying the determinants, rather than the consequences, of investors' risk judgments, we chose to focus on obtaining unbiased risk assessments and did not examine subsequent decisions or market behavior. Prior research suggests that the perceived riskiness of financial items is an important factor in investors' financial decisions (cf. Coombs 1975; March and Shapira 1987). Consequently, we expect that the effects we demonstrate will also be reflected in investors' financial decisions (Ganguly, *et al.* 1994; Camerer, *et al.* 1989). Thus, future studies could extend our findings by examining how and when the Slovic variables affect investors' financial decisions and market behaviors.

ENDNOTES

¹ Although the decision theory perspective can be statistical in nature (e.g., using calculated variance as a measure of risk), it also can be viewed in terms of perceptions, such as how people perceive probability data (e.g., Weber 1988) or react to variance (e.g., Lipe 1998). Our paper deals with how people *perceive* decision theory variables.

² Although some of our financial items are derivatives, we did not specify whether these derivatives were used as hedges or for speculative purposes. While such information may have enhanced the external validity of our study, it was unnecessary for our research purposes. That is, the means of each dependent variable would be systematically higher for derivative instruments but the correlations among the variables would likely be unchanged (Koonce, *et al.* 2003).

³ It was necessary to keep the same questions for each of the items to conduct our regression tests. Consequently, we could not tailor the risk questions to the specific features of a particular item (e.g., ask about *fair value* risk for fixed-rate debt and the *cash flow* risk for variable-rate debt).

⁴ While not an explicit part of our design, the fact that we had multiple (i.e., 19) financial items with multiple questions for each item (i.e., 13) also suggests that it is unlikely that participants would be able to successfully justify their risk assessments by selectively weighting certain variables. While a participant might be able to keep their implicit justification model in mind for one or two financial items, this cognitive task would become overwhelming with 19 items – items that were chosen to vary on the perceived levels of the decision theory and Slovic variables. Indeed, one might expect that participants would simplify the task and focus on one or two variables. Alternatively, *if* participants could master the cognitive challenges noted above and *if* they were justifying their risk assessments by weighting variables, then it might follow that *all* Slovic and decision theory variables would be explanatory in the regressions. As detailed later in the paper, neither scenario is consistent with our results.

⁵ It might be argued that the relatively high explanatory power of Model 2 is due to the brief descriptions of the financial items. That is, it may have been relatively easier to rate the Slovic variables than the decision theory variables under these conditions. If this is the case, the standard deviations should be smaller for the Slovic variables than the decision theory variables. However, we find that the standard deviations of the Slovic variables are *larger* than those for the decision theory variables for a majority of the possible pairwise comparisons (36 out of 45 possible comparisons). These tests suggest that, if anything, the study participants found it harder to rate the Slovic variables.

⁶ Even if one were to argue that both Slovic and decision theory variables are measuring the same basic construct but with error, we would still maintain that including both sets of variables in a descriptive risk model enhances our understanding of how individuals judge risk and is strictly better than using either set separately. This type of reasoning is common in accounting research (see Barth, *et al.* 1996 529). However, to further bolster our argument that the Slovic variables are not measuring the same basic construct as the decision theory

variables, we conducted a factor analysis with the responses to the decision theory and Slovic questions. If the Slovic variables are merely surrogates for the decision theory variables, then we would expect to see only one, or perhaps two, factors emerging, corresponding to probabilities and outcomes. Instead, we observe four factors emerging, suggesting that our participants did not consider the Slovic variables to be subsumed by the decision theory variables.

⁷ We conducted another study with a separate group of 40 participants where we provided them with the same nineteen financial items used in this study, but indicated only how a loss outcome could occur (i.e., we did not indicate how a gain outcome could occur). We asked them the same Slovic and risk questions as used in this study, and asked them to rate the two loss-related decision theory questions (i.e., we did not include the two gain questions and the status quo question). Results from this study are very similar to those reported here. That is, both the decision theory and Slovic variables are important to understanding investors' risk judgments, and a model containing both sets of variables has greater explanatory power than models with either set of variables alone.

⁸ Further, if our elicitation techniques do cause justification behavior, then our R^2 statistics would be inflated for all three models tested in Table 2. We compare R^2 statistics across models rather than analyze the level of R^2 for any particular model. By comparing nested models, we control for any common inflation.

⁹ Pilot testing revealed that participants could reasonably evaluate only about six financial items when they were set within the context of detailed risk disclosures, so it was not possible to investigate as many items as in study 1.

¹⁰ We chose to manipulate a decision theory variable, rather than a Slovic variable, for several reasons. First, manipulating a Slovic variable would not have allowed us to test our hypothesis that decision theory variables influence Slovic variables. That is, manipulating a Slovic variable would only have allowed us to test its direct effect on investors' risk judgments. Because current accounting risk disclosures focus on decision theory information (i.e., loss outcome and/or loss probability), we felt it was more important to fully understand the implications of that information. Second, in real-world accounting risk disclosures, the analogs of the Slovic variables either are not disclosed (i.e., newness of risks) or do not exhibit much variation. For example, most accounting risk disclosures contain boilerplate statements about controllability. Manipulating controllability at high and low levels would be perceived as unusual and artificial because companies do not normally admit their weaknesses in controlling potential risks.

¹¹ In study 2, we also included an open-ended question in the instrument asking participants to indicate the dimensions they consider when evaluating risk. We coded each component of their responses as being consistent with the decision theory, Slovic, or neither perspective. Based on these responses, we divided participants into four groups (i.e., decision theory, Slovic, mixed, and other). We estimated Model 3 separately for each of these four groups and did not find that participants' risk assessment patterns were systematically associated with the weights they place on the model variables. That is, both decision theory and Slovic variables

remain important in all of the models regardless of what participants indicated on the open-ended question.

¹² We use structural equation modeling instead of multivariate regression analysis with interaction terms, because the former allows us to capture the separate effects of loss outcome influencing dread (Link 2) and the effect of dread on risk (Link 3). In contrast, a multivariate regression interaction term (i.e., 0/1 loss outcome interacted with the Slovic dread factor, for example) essentially collapses the link from loss outcome to dread (link 2) with the link from dread to perceived risk (link 3). Thus, with a multivariate regression approach, we lose valuable information about the separate relations between loss outcome and the Slovic factors as well as Slovic factors and risk.

¹³ It is not possible to conduct the structural equation modeling with all of the individual Slovic questions. Because the eight Slovic questions capture two constructs – dread and unknown – there is high correlation among them. Proper specification of the model would necessitate including parameters for the covariances among the questions, thereby leading to an underidentified model whereby the number of parameters to be estimated exceeds the number of variances and covariances (i.e., data points). Underidentified models lead to an infinite number of possible solutions (Byrne 2001 35).

¹⁴ The most important variables underlying the two factors (as evidenced by the size of the factor loadings) are identical between our study and Slovic's original work (1987). However, a few variables load differently. Our factor analysis results appear to be reliable, though, as a factor analysis on the study 1 Slovic responses reveals results identical to those for study 2. Nevertheless, to ensure that these different factor loadings are the result of the different items being rated in our study versus Slovic's (and not due to the different type of study participant), we asked a separate group of twenty participants with the same demographics as our study participants to respond to the Slovic questions for a set of health and technological risks. A factor analysis reveals two dimensions that perfectly replicate those documented by Slovic with these stimuli. Thus, the observed differences in our study 2 factors appear to be due to the different items being rated rather than our study participants' education and training.

¹⁵ Conducting the structural equation modeling by ignoring the non-independence of our observations yields results that are qualitatively similar to those reported in the paper. Further, separate structural equation models for each of the six items reveals that an indirect model (i.e., including all three links shown in Figure 3) is significantly more explanatory than the direct model (i.e., only Link 1) (all p -values < 0.01).

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TABLE 1
DESCRIPTIVE STATISTICS FOR STUDY 1 AND STUDY 2

Panel A: Means and standard deviations

Variables	STUDY 1		STUDY 2 Low-loss condition		STUDY 2 High-loss condition	
	(N=747)		(N=299)		(N=300)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Loss Probability	44.0	18.0	49.1	20.4	47.3	21.2
Loss Outcome	35.1	22.9	35.8*	22.0	43.9	22.7
Gain Probability	43.4	18.0	40.2	21.8	40.4	21.5
Gain Outcome	33.8	22.6	29.3*	20.9	34.5	24.0
Status Quo Probability	35.8	25.9	37.0	25.3	38.6	23.6
Worry	37.6	26.0	42.8*	24.8	48.2	26.9
Catastrophic	28.4	23.8	31.7*	21.6	35.6	22.8
Voluntary	71.5	26.1	63.1*	25.7	58.2	27.7
Newness	28.3	27.8	29.2	24.7	31.1	25.4
Immediacy	67.3	24.0	59.1*	26.5	63.8	27.1
Control	51.9	27.6	51.2	25.5	50.1	26.6
Known by Participant	55.5	25.3	55.6	25.5	58.8	25.3
Known by Management	37.7	25.2	35.1	22.8	37.1	24.5
Risk	43.3	24.4	45.7*	22.4	51.8	23.6

This Panel reports the means and standard deviations for the Slovic and the decision theory variables. These statistics are calculated over all participants and all financial items. See Figure 1 for a list of the financial items included in each study and Figure 2 for a description of the Slovic and decision theory questions.

*Indicates that the variable mean for the low-loss condition is significantly different than the variable mean for the high-loss condition at $p < 0.05$.

TABLE 1 (continued)*Panel B: Correlations*

	Loss Probability	Loss Outcome	Gain Probability	Gain Outcome	Status Quo Probability	Worry	Catastrophic	Voluntary	New	Immediacy	Control	Known by Participant	Known by Management	Risk
Loss Probability	1.00	0.41*	-0.18*	-0.01	-0.33*	0.44*	0.32*	-0.30*	0.12*	-0.10*	-0.19*	-0.16*	-0.13*	0.43*
Loss Outcome	0.26*	1.00	0.03	0.45*	-0.18*	0.53*	0.62*	-0.45*	0.17*	-0.12*	-0.25*	-0.24*	-0.15*	0.58*
Gain Probability	0.13*	0.19*	1.00	0.56*	-0.02	-0.06	0.00	0.09*	-0.02	-0.02	0.10*	0.01	0.06	-0.05
Gain Outcome	0.19*	0.67*	0.40*	1.00	-0.01	0.17*	0.27*	-0.09*	0.09*	-0.10*	-0.07	-0.10	-0.04*	0.21*
Status Quo Probability	-0.23*	-0.07	-0.27*	-0.14*	1.00	-0.19*	-0.14*	0.16*	-0.01	-0.01	0.07	0.16*	0.15*	-0.26*
Worry	0.31*	0.54*	0.07	0.39*	-0.05	1.00	0.59*	-0.60*	0.39*	-0.12*	-0.32*	-0.26*	-0.24*	0.68*
Catastrophic	0.29*	0.69*	0.11*	0.53*	-0.01	0.67*	1.00	-0.52*	0.24*	-0.11*	-0.28*	-0.23*	-0.18*	0.59*
Voluntary	-0.12*	-0.32*	-0.04	-0.19*	0.04	-0.50*	-0.41*	1.00	-0.30*	0.16*	0.37*	0.29*	0.27*	-0.54*
New	0.17*	0.24*	0.15*	0.21*	0.05	0.36*	0.27*	-0.34*	1.00	-0.04	-0.20*	-0.19*	-0.19*	0.30*
Immediacy	-0.04	-0.16*	-0.05	-0.16*	0.09*	-0.22*	-0.17*	0.29*	-0.18*	1.00	0.04	0.07	0.03	-0.11*
Control	-0.20*	-0.27*	-0.13*	-0.21*	0.20*	-0.29*	-0.30*	0.29*	-0.22*	0.12*	1.00	0.32*	0.39*	-0.37*
Known by Participant	-0.11*	-0.24*	-0.10*	-0.18*	0.10*	-0.28*	-0.26*	0.28*	-0.32*	0.11*	0.42*	1.00	0.58*	-0.30*
Known by Management	-0.15*	-0.25*	-0.13*	-0.23*	0.11*	-0.30*	-0.31*	0.27*	-0.28*	0.20*	0.57*	0.69*	1.00	-0.26*
Risk	0.37*	0.56*	0.14*	0.40*	-0.09*	0.65*	0.61*	-0.40*	0.24*	-0.18*	-0.35*	-0.33*	-0.39*	1.00

This Panel reports the correlations among the Slovic and the decision theory variables and the perceived risk variable. We show study 1 correlations below the diagonal and study 2 correlations above the diagonal. We calculate correlations across all participants and all financial items in their respective studies. See Figure 1 for a listing of the financial items included in each study and Figure 2 for a description of the Slovic and decision theory questions.

* Indicates that the correlation is significantly different than zero at $p < 0.05$.

TABLE 2
FIXED-EFFECTS ORDINARY LEAST SQUARES
REGRESSIONS FOR STUDIES 1 AND 2

Panel A: Study 1

<u>Independent Variables</u>	<u>Model 1</u> <u>Coefficients</u>	<u>Model 2</u> <u>Coefficients</u>	<u>Model 3</u> <u>Coefficients</u>
Intercept	16.98*	44.70*	28.09*
Loss probability	0.32*		0.15*
Loss outcome	0.49*		0.19*
Gain probability	0.04		0.03
Gain outcome	0.10 [†]		0.09*
Status quo probability	-0.05		-0.01
Worry		0.35*	0.31*
Catastrophic		0.33*	0.20*
Voluntary		-0.11*	-0.10*
Newness		-0.01	-0.03
Immediacy		0.01	0.03
Control		-0.09*	-0.07*
Known by management		-0.12*	-0.12*
Adjusted R ²	54.8%	68.2%	71.5%

Panel B: Study 2

<u>Independent Variables</u>	<u>Model 1</u> <u>Coefficients</u>	<u>Model 2</u> <u>Coefficients</u>	<u>Model 3</u> <u>Coefficients</u>
Intercept	31.01*	56.80*	51.32*
Loss probability	0.21*		0.07 [†]
Loss outcome	0.45*		0.12*
Gain probability	-0.09 [†]		-0.03
Gain outcome	0.12 [†]		0.09 [†]
Status quo probability	-0.12*		-0.08 [†]
Worry		0.27*	0.22*
Catastrophic		0.25*	0.18*
Voluntary		-0.20*	-0.17*
Newness		0.02	0.04
Immediacy		-0.02	-0.01
Control		-0.11*	-0.09*
Known by management		-0.08*	-0.06 [†]
Adjusted R ²	48.0%	63.2%	65.1%

Notes on following page:

TABLE 2 (continued)

Notes for Table 2:

This table reports the results of the following three regression models:

Model 1:

$$\text{Risk} = \alpha_1 + \beta_1 (\text{Loss probability}) + \beta_2 (\text{Loss outcome}) + \beta_3 (\text{Gain probability}) + \beta_4 (\text{Gain outcome}) \\ + \beta_5 (\text{Status quo probability}) + \varepsilon_1$$

Model 2:

$$\text{Risk} = \alpha_2 + \beta_6 (\text{Worry}) + \beta_7 (\text{Catastrophic}) + \beta_8 (\text{Voluntary}) + \beta_9 (\text{Newness}) + \beta_{10} (\text{Immediacy}) \\ + \beta_{11} (\text{Control}) + \beta_{12} (\text{Known by management}) + \varepsilon_2$$

Model 3:

$$\text{Risk} = \alpha_3 + \beta_{13} (\text{Loss Prob.}) + \beta_{14} (\text{Loss Outcome}) + \beta_{15} (\text{Gain Prob.}) + \beta_{16} (\text{Gain Outcome}) \\ + \beta_{17} (\text{Status Quo Prob.}) + \beta_{18} (\text{Worry}) + \beta_{19} (\text{Catastrophic}) + \beta_{20} (\text{Voluntary}) + \beta_{21} (\text{Newness}) \\ + \beta_{22} (\text{Immediacy}) + \beta_{23} (\text{Control}) + \beta_{24} (\text{Known by management}) + \varepsilon_3$$

The dependent measure for each regression is the perceived risk that participants assessed for each of the nineteen (six) financial items used in study 1 (study 2). The independent variables are the participants' responses to the Slovic and decision theory questions for each of the financial items. See Figure 2 for a list of these questions. We estimate all models with one-way fixed effects: included in each study 1 (study 2) regression, are 39 (99) participant-specific indicator variables. We suppress these intercepts for presentation purposes.

* $p < 0.01$

† $p < 0.05$

TABLE 3
FACTOR ANALYSIS FOR STUDY 2 SLOVIC QUESTIONS

	Factor 1*	Factor 2*
Worry	0.832	-0.212
Catastrophic	0.780	-0.143
Voluntary	-0.763	0.282
New	0.494	-0.208
Immediacy	-0.303	-0.059
Control	-0.301	0.599
Known by management	-0.042	0.873
Known by participant	-0.095	0.828

This table reports the factor patterns obtained from a principal component analysis with a varimax rotation, using study 2 participants' responses to the Slovic questions. See Figure 2 for a description of the Slovic and decision theory questions.

* Bolded numbers indicate the largest factor loading for a particular question.

FIGURE 1
FINANCIAL ITEMS USED IN STUDIES 1 AND 2

Panel A: Study 1 Financial items

1. Accounts Receivable
2. Cash
3. Commodity Forward Contract (long position)
4. Common Stock Investment
5. Currency Butterfly Spread (long position)
6. Defined-Benefit Pension Liability
7. Employee Stock Options with Repricing Feature
8. Equity Call Option (long position)
9. Equity Call Option (short position)
10. Fixed-rate European Currency Unit (ECU) Bonds Investment
11. Fixed-rate Debt
12. Foreign Currency Future (long position)
13. Foreign Currency Future (short position)
14. Interest Rate Swap (fixed to variable)
15. Interest Rate Swap (variable to fixed)
16. OPPOSSM Put Options (short position)
17. Property, Plant, & Equipment
18. SPIN Indexed Notes Investment
19. Variable Rate Debt

Panel B: Study 2 Financial items

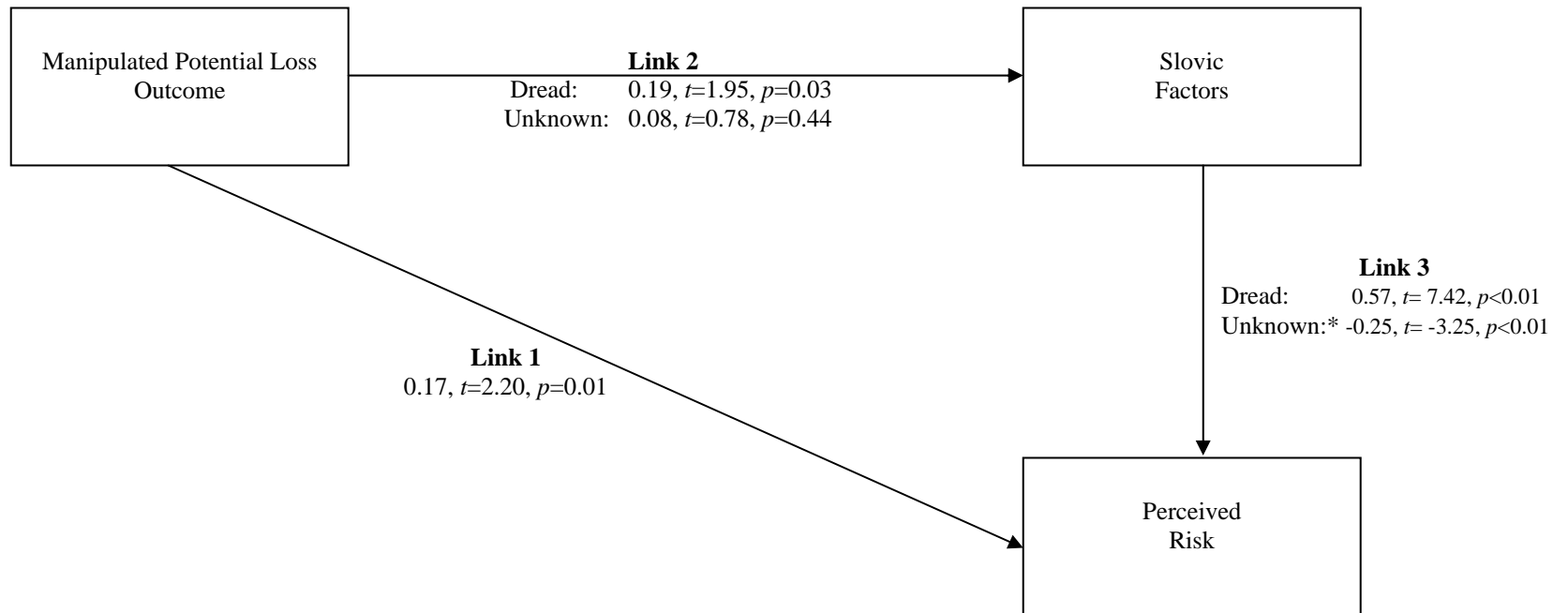
1. Commodity Futures Contract (long position)
2. Common Stock Investment
3. Equity Call Option (short position)
4. Fixed-rate Debt
5. Foreign Currency Forward Contract (long position)
6. Other Post-Retirement Benefit Liability

FIGURE 2
QUESTIONS USED IN STUDIES 1 AND 2

<p>Are the risks to the company from the <u>financial item</u> new, novel ones or old, familiar ones? (endpoint 0 was labeled <i>old</i> and endpoint 100 was labeled <i>new</i>)</p>
<p>Are the risks to the company from the <u>financial item</u> ones that cause you to worry or do they cause you no worry? (endpoint 0 was labeled <i>no worry</i> and endpoint 100 was labeled <i>high worry</i>)</p>
<p>To what extent are the risks to the company from the <u>financial item</u> known precisely by company management? (endpoint 0 was labeled <i>not known</i> and endpoint 100 was labeled <i>known precisely</i>)</p>
<p>To what extent are the risks to the company from the <u>financial item</u> known precisely by you, as an investor? (endpoint 0 was labeled <i>not known</i> and endpoint 100 was labeled <i>known precisely</i>)</p>
<p>To what extent are the risks to the company from the <u>financial item</u> likely to be catastrophic? (endpoint 0 was labeled <i>not likely to catastrophic</i> and endpoint 100 was labeled <i>likely to be catastrophic</i>)</p>
<p>How difficult is it for the company's management to use their skill and diligence to control (limit) the risks of the <u>financial item</u>? (endpoint 0 was labeled <i>very difficult to control</i> and endpoint 100 was labeled <i>very easy to control</i>)</p>
<p>Would you voluntarily invest in a company that has <u>financial item</u> or would such an investment only occur if you were unaware of the <u>financial item</u> (involuntarily)? (endpoint 0 was labeled <i>involuntary</i> and endpoint 100 was labeled <i>voluntary</i>)</p>
<p>To what extent are the risks associated with the <u>financial item</u> immediate or are they likely to occur over time? (endpoint 0 was labeled <i>immediate</i> and endpoint 100 was labeled <i>over time</i>)</p>
<p>What do you think is the probability of an economic loss to the company from the <u>financial item</u>? (endpoint 0 was labeled <i>zero probability</i> and 1.00 endpoint was labeled <i>certainty</i>)</p>
<p>If there were an economic loss to the company from the <u>financial item</u>, how big a loss would you expect? (endpoint 0 was labeled <i>zero loss</i> and endpoint 100 was labeled <i>very large loss</i>)</p>
<p>What do you think is the probability of an economic gain to the company from the <u>financial item</u>? (endpoint 0 was labeled <i>zero probability</i> and 1.00 endpoint was labeled <i>certainty</i>)</p>
<p>If there were an economic gain to the company from the <u>financial item</u>, how big a loss would you expect? (endpoint 0 was labeled <i>zero gain</i> and endpoint 100 was labeled <i>very large gain</i>)</p>
<p>What do you think is the probability of the status quo (neither an economic gain nor an economic loss) to the company from the <u>financial item</u>? (endpoint 0 was labeled <i>zero loss</i> and endpoint 100 was labeled <i>very large loss</i>)</p>
<p>Overall, how risky is the <u>financial item</u> to the company? (endpoint 0 was labeled <i>no risk</i> and endpoint 100 was labeled <i>high risk</i>)</p>

This figure describes the questions used in studies 1 and 2. With the exception of the probability questions, each question uses a 101-point scale with appropriately labeled endpoints. The numerical labels for the probability questions are true probability scales that range from .00 to 1.00. To minimize the potential for spurious correlations caused by participants merely responding at the same general area on the scale for all of the questions, we use reverse scaling for several questions (voluntary, control, and the two knowledge questions). Thus, a "logical" response for any given item requires the subject to respond high on the scale for some questions and low on the scale for other questions.

FIGURE 3
STRUCTURAL EQUATION MODEL TESTS – STUDY 2



This figure shows the results of the structural equation (i.e., path) analysis to test the interrelationships between the decision theory and Slovic variables in investors' risk perceptions. Shown next to each link are the standardized path coefficients and corresponding t -statistics and p -values (all are one-tailed except for Link 2 for the unknown question where no directional relationship was expected). Overall goodness of fit is measured by the Comparative Fix Index (99.1%), which measures the proportion of improvement of the fit of the model over a null model.

*This negative coefficient on the unknown factor indicates that as the item is more known (i.e., less unknown), it is perceived as less risky.