RELATIVE PERFORMANCE EVALUATION: The Effect of Contract Type, Feedback and Task Environment on Agent Risk Preferences 1

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Ttilon ini merupakan hasil penelitian eksperimental yang meneliti pengaruh jenis kontrak, kompensasi (relative performance evaluation (RPE)) vs profit sharing (PS), feedback, dan sifat pekerjaan (pekerjaan yang memerlukan satu tugas eksklusi (single task) dan pekerjaan yang memerlukan dua tugas eksklusi (dual task)) pada tingkat preferensi risiko agen. Penelitian ini menguji hipotesis bahwa agen yang mempunyai kontrak RPE, feedback negatif dan single task akan memiliki tingkat preferensi risiko yang lebih tinggi dibanding dengan agen yang mempunyai kontrak PS, feedback positif dan dual task.

Penelitian eksperimental ini menggunakan metode bimanis bimak tingkat graduan untuk menguji hipotesis tersebut. Penelitian ini menunjukkan bahwa jenis kontrak dan sifat feedback (positif dan negatif) serta sifat pekerjaan mempengaruhi tingkat preferensi risiko. Agen dengan jenis kontrak RPE dan feedback negatif mempunyai tingkat preferensi risiko yang lebih tinggi dari pada agen dengan jenis kontrak PS dan feedback positif. Penelitian ini juga menunjukkan bahwa pengaruh jenis kontrak tergantung pada sifat pekerjaan. Jika pekerjaan (singl atau dual) mempunyai pengaruh pada tingkat preferensi risiko hanya apabila agen mempunyai kontrak PS, tidak pada agen yang mempunyai kontrak RPE.

Keywords: relative performance evaluation, profit sharing; feedback signs, single and dual task; agent risk preferences.2

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2 Readers may have the manuscript instead by contacting the writer.
Introduction

Individual risk preferences have been a major issue in accounting studies. These studies propose that compensation contracts (e.g., relative performance evaluation (RPE) and profit sharing (PS)) and control feedback are important variables that affect individual risk preferences (Demski and Kepp, 1982; Dye, 1992). Field studies indicate that superiors attempt to motivate and to induce risk preferences of their agents by different types of compensation contracts and control feedback (Maier, 1987; Merchant, 1989). Two lines of literature address the relationships between those variables and risk preferences separately: agency theory and prospect theory. This study examines the complementarity between these theories in explaining individual risk preferences. This study adds to accounting and incentive contracting literature with specific focus on the effects of (1) contract type (RPE and PS); (2) task environments (dual vs. single task); and (3) feedback sign, on manager risk selection.

This study contributes to the literature in two respects. First, evidence is provided on the Demski and Suppington (1987) proposition about the effects of a dual task environment on agent risk preferences. Demski and Suppington proposed that single task agents (i.e., agents whose task is just to select an investment) are more risk seeking than dual task agents (i.e., agents whose task is not only to select an investment, but also to search for information about investment opportunities). There is no empirical study that examines this proposition. This study attempts to fill this void.

Second, extending the works of Frederickson (1992) and Chow and Hodda (1991), this study examines the effect of feedback sign on agent risk selection as explained in Kahneman and Tversky's (1979) prospect theory and the interaction effects between contract type and feedback sign on agent risk preferences. A laboratory experiment involving graduate business students were conducted to test the hypotheses regarding the effect of contract type, feedback sign, and task environment on risk preferences. This study found significant main effects of contract type and feedback sign on agent risk preferences as explained in principal agent and prospect theory. Further, this study found a significant main effect of task environments on agent risk preferences. The interaction effect between contract type and task environments is significant, whereas the other interaction effects are not significant.

The rest of the paper is organized as follows. The next section discusses the literature review and the development of hypotheses. Section three describes the research method to test the hypotheses. Section four discusses the results and analysis, and section five provides the conclusions, the limitations of the findings and potential extensions of the study.

1 RPE refers to a compensation contract that evaluates managers based on their performance compared to the average performance of their group, while PS refers to a compensation contract that evaluates managers based on a person standard (Frederickson, 1991; Chow and Hodda, 1991).

2 For examples, Hamermesh (1979, 1982) and Hamermesh and Milgrom (1994), among others, represent agency theory studies that address management's effort and risk selection. In organizational theory and psychology, Figure et al. (1979), Locke et al. (1981) and Lyubomir and Leventhal (1995) present studies in psychology that address the effects of feedback on managers' effort while Kahneman and Tversky (1979) provide an analysis about the effects of feedback in terms similar to an individual's positive (or negative) on risk selection.
Literature Review and Development of Hypotheses

Holmstrom (1982) proposes that RPE contracts can result in greater risk taking behavior than PS contracts. Given another agent's behavior, RPE contracts used to induce effort may result in inefficient risk sharing, while optimal risk sharing can be maintained in RPE contracts. In PS contracts, the agent's outcome, $x$, is a function of effort and the state of nature:

$$ x = h(k, s) $$

where $h$ is agent’s effort and $s$ is the state of nature. Since $x$ is uncertain, it is a noisy signal of $h$. Hence, contracts of the form:

$$ m_n = F + j(x - X_j) $$

where:

- $m_n$: profit sharing based compensation
- $F$: fixed amount of the compensation
- $j$: the compensating rate
- $x$: agent's output
- $X_j$: agent j's past standard

that imposes risk on risk averse agents are inefficient risk sharing contracts between principals and agents (Holmstrom, 1980). On the other hand, in RPE contract that can be stated simply as:

$$ m_n = F + j(x - s) $$

where $m_n$ is RPE based contract, $s$ is the average performance of the managers' group, and the other terms are similar to the equation two, the principals seek to maximize net expected profit subject to two constraints: every agent receives an expected utility at least equal to that of the next best alternative, and each agent’s action is a best response to his/her agent's behavior under a certain sharing rule. In this situation, Holmstrom (1982) proves that the sharing rule based on each agent's output and the weighted average of all agents' performance measures is optimal, because the average peer performance measure captures the relevant information about common uncertainty (Theorem 6, Holmstrom, 1982). The optimal sharing rule under RPE implies that RPE agents demonstrate more risk seeking behavior than PS agents do.

Chow and Haddad (1991) examine Holmstrom's (1982)'s proposition in an experimental involving graduate students. They examine whether RPE contracts force higher risk seeking behavior than do PS contracts. Consistent with Holmstrom's proposition, Chow and Haddad found that under high uncertainty, RPE subjects demonstrate higher risk seeking behavior than do PS subjects. The first hypothesis of this study, replicating Chow and Haddad (1991) examines the effects of performance evaluation on agents' risk selection.

H1: RPE managers demonstrate higher risk seeking behavior than do PS managers.

The Effect of the Dual Task Environment on Agent Risk Selection

Denis and Sapphyeon (1987) and Lamdot (1986) show that dual task environments can result in the agents making different risk selection from those made by agents in a single task environment. Similarly, Holmstrom and Ougrorn (1994) prove that a multidimensional task environment, incentive contracts that focus on
a single dimension can dominate another dimension of the task. Demski and Sappington (1987) model a dual task environment using division managers who have planning and implementation contracts. In this study, dual task division managers are contracted to search for information about alternative investments and to select an investment project.

The Demski and Sappington model assumes that:
1. the principals are risk neutral and the agents are risk averse;
2. perfect communication between the principals and agents is costly;
3. there is a set of effort levels where each feasible level (he Hj) if chosen, provides alternative project opportunities (ye Yj) that inform agents to choose an action (ae A) to select a project.

Only agents observe effort levels (he Hj), investment opportunities (ye Yj), and their investment choices (ae Aj). Both agents and principals observe the actual random outcome (xe Xj). The model also assumes that the principals have objective functions to maximize the expected value of random outcomes (xe Xj) less payments to the agents (ae A). If xe Xj is the state of nature, and ae A is an investment selected by the agents, the outcomes model is xe Xj via ae A where X, S, and d are finite. Agents and principals initially share homogenous beliefs about the random state of nature represented by the probability mass function P (i) > 0 for all xe S.

The contracting and transaction process between dual task agents and principals is illustrated in Figure 1 and explained as follows:
1. managers' compensation as a function of outcomes, xe Xj, is specified;
2. managers commit to an effort level (he Hj, observe alternative projects, ye Yj, and take an action selecting a project, ae A);
3. outcomes xe Xj are observed by both managers and principals; and
4. managers are compensated.

Figure 1. Transaction Process Between Principals and Agents in a Dual Task Environment

<table>
<thead>
<tr>
<th>Compensation contract is specified</th>
<th>Effort is committed (he Hj)</th>
<th>Investment opportunities found (ye Yj)</th>
<th>An investment is selected (ae A)</th>
<th>Output is observed &amp; compensation is paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Task 2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 For example, an incentive system based upon product quantity may result in lower product quality, and an incentive system that focuses on product quality may improve the cost of equipment maintenance and repair (Dhaliwala and Stiglitz, 1994).
2 The term he Hj means an effort level is a subset of all possible effort levels. Hereafter all capital letters in the terms indicate all possible alternatives of the lower case terms that precede them.

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Based on these assumptions and transaction processes, principals attempt to maximize their utility according to the objective function and its related constraints as follows (Demski and Sappington, 1987):

\[ \text{PO: Maximize } \text{ utility} \]

subject to:

\[ \text{R: Demand on } (x, y, h, k) \text{ for } (s, \theta, p, x, h) \geq 0. \]

\[ \text{S: Selection on } (x, y, h, k) \text{ for } (s, \theta, p, x, h) \geq 0. \]

\[ \text{AS: Investment on } (x, y, h, k) \text{ for } (s, \theta, p, x, h) \geq 0. \]

where,

- \( \pi \) = principals' and agents' homogeneous beliefs about the state of nature
- \( m \) = agents' compensation
- \( U \) = agents' utility
- \( \bar{U} \) = an alternative utility available from alternative employment

\( h' \) = alternative effort committed by agents

\( \alpha \) and \( \beta \) = alternative investment selected given different principals' employment policy (i.e., job and organizational-design and incentive contracts), \( f(x, p, y, h) \) denotes the induced distribution

1. Under uncertainty and information asymmetry, the direct solution (proportionalies) cannot be achieved. Using contract constraints that are tied to agents' outcomes can increase principal's belief, but it can also increase agents' effort aversion and risk aversion. This situation is called the second-best solution in analytical studies.
their limited capacity. In addition, exerting effort more than a maximum level is costly for the agents.

Dembcz and Sappington (1987) show that the AS constraint binds in the solution of PD when the incentive structure is to motivate the agents to choose the desired effort level α. This means the induced moral hazard problem is present in the project selection. The risky incentive structure that motivates agents to choose the project selection because agents may wish to avoid bad signals about the preceding task. A result from the context of selecting a risky project. Lambert (1996), Holmström and Riordan (1996), Dye (1992) and Holmström and Milgrom (1994) address different dual task settings. Their results, however, do not contradict Dembcz and Sappington (1987).

Thus, based on the discussion above, this study hypothesized that division managers who have dual tasks such as seeking investment project opportunities and selecting one of the projects choose less risky projects. In contrast, division managers who have a single task, for example those who are provided with project opportunities from a research and development division and their job is just to select the project, choose riskier projects.

H2: Dual task managers demonstrate lower risk seeking behavior than do single task managers.

The Interaction Effect Between Contract Type (RPE vs. PS) and Task Environment (Dual vs. Single Task) on Agent Risk Selection

In RPE contracts, agent output is not the only source of information about investment selection. RPE contracts also provide peer average performance information (see Proposition 2) that indicates information about common uncertainty faced by the agents. In this situation, agents may have a perception that their performance is evaluated by superiors based upon not only their own output but also the common uncertainty condition derived from the peer output average information. As a consequence, the average information may mitigate bad signals about agent selection given that agents exert a high effort level and select a risky project. In contrast, in PS contracts, agent output is the only source of information about the agent effort and investment selection. In this situation the induced moral hazard in investment selection may exist meaning that agents may select a less risky project even if they exert higher effort and they have profitable but riskier projects in their selection set (Lambert, 1986). Considering the effects of RPE and PS contracts above, it is expected that RPE contracts mitigate induced moral hazard in investment selection, while PS contracts do not. Thus, there are interaction effects between contract type and task environment on agent risk selection.

H3: There is an interaction effect between contract type and task environment such that the difference in risk seeking behavior between dual task and single task managers is lower in RPE than that in PS contracts.

The Effect of Feedback Sign on Agent Risk

The effects of feedback on agent risk selection may be explained by prospect theory. The most relevant feature of prospect theory in this study is that a reference point affects risk selection (Kahneman and Tversky, 1979).
and Tversky, 1979; Tversky and Kahneman, 1981; Payne et al., 1980, 1981; Kim, 1992). The theory suggests that individuals are risk averse when they are above the reference point (a gain) or a positive feedback situation and are risk seeking when they are below the reference point (a loss situation). The effectiveness of peer average performance as a reference point has been documented in previous studies (Fischbom, 1977; Payne et al., 1980, 1981; Kim, 1992). Payne et al. (1988, 1981) find that the peer based performance evaluation as a reference point is an important factor in determining business managers' risk selection. Kim (1992) demonstrates that information about individual performances compared to a group average affect risky budget choices. Relying on such works, RFE and feedback can provide the reference point for agents so that agents who have positive feedback perceive that they are in a gain domain and become more risk averse while those who have negative feedback perceive that they are in a loss domain and become more risk-seeking. Individuals who have negative feedback choose a risky investment because the reward associated with successful investment is sufficiently large to make up for underinvestment in the previous period. Thus, it is predicted that agents in gain domains will tend to be more risk-averse and those in loss domains will tend to be more risk-seeking. The next hypothesis predicts the effect of feedback sign on agent risk selection.

H4: Agents with negative feedback are more risk seeking than do agents with positive feedback.

Based on prospect theory, PS and RFE agents whose position is above the standard tend to be more risk averse while those whose position is below the standard tend to be more risk seeking. However, since the degree of saliency and credibility of the RFE and PS based feedback is different (Praduao and Fehr, 1989), there may be an interaction effect between contract type and feedback on agent risk selection.

H5: There is an interaction effect between contract type and feedback sign on agent risk selection so that the difference between RFE and PS agent risk selection is higher when there is negative feedback than when there is positive feedback.

Research Method

An experiment involving graduate business students were conducted to test the hypotheses. The design of the experiment was a 2 x 2 factorial design. The first factor was contract type (two levels: RFE and PS) and the second factor was feedback sign (gain or loss).

* For example, in Kahneman and Tversky’s (1979) experiment, in a game (1,000) vs. (4,000, 80), individuals tend to choose (1,000) rather than the latter. However in a (-1,000) vs. (-4,000, 80) game, individuals tend to choose (-4,000, 80).

* The use of peer average as a reference point is different from that suggested by benchmarking literature (e.g., Camp, 1989; Swedlow, 1994) who suggest the use of the best performance as the reference point. However, in 1992, Jung et al. suggests that the use of peer based performance as a reference point can not efficiently reveal information about common uncertainty. In addition, the benchmarking literature tends to focus on the use of the best performer as a benchmark to build organizational value, while this study focuses on the effects of feedback to influence agent effort and risk taking.

* Detailed in Kong (1985) suggested the use of laboratory experiments for testing the analytically derived results. The use of laboratory experiments have advantages (e.g., high internal validity and weak threats to external validity). Swets and Wachtel (1987) provide a detailed discussion of the use of laboratory experiments in accounting research.
and PS) and the second factor was feedback sign (two levels: positive and negative). The third factor was the task environments (two levels: dual task, effort investment selection) and a single task (investment selection only). All of the factors are randomly assigned between subjects. Figures 2 illustrate the assignment of the subjects to each factor.

Figure 2 illustrates that the experiment included eight experimental groups, which had different contact type, feedback sign, and task environments. The experiment asked the subjects to respond to the investment selection decisions. The subjects assigned to the dual-task group responded to investment selection decisions after they had responded to an effort decision. This group was compared to the single-task group, which consisted of subjects who made a task selection decision only to test the task environment hypothesis (hypothesis 3). In the dual-task environment, the subjects played the role of division managers who had the responsibility of finding the information about investment opportunities and selecting one investment project from the opportunities found. On the other hand, in the single-task situation, the subjects played the role of division managers who were provided with investment opportunities from another division (i.e., research and development division) and their task was to select an investment project.

The data about agents risk selection were analyzed using analysis of variance (ANOVA). The analysis assumed that the dependent variables are normally distributed and homoscedastic. Wilk-Shapiro statistic was used to test the normality by Hartley's and Bartlett's Box tests were conducted to check the homoscedasticity assumption (Keppel, 1982, Keppel, 1991).

Footnote: The between-subject design is used for the following reasons: (1) maintaining consistency with the previous studies being extended, and (2) obtaining the responsibility between the response scale of dual-task and single task subjects. The use of between-subject design has advantages and disadvantages (e.g., power of analysis, and external and internal validity). Fawcett and Zuckerman (1987) and Sheppard et al. (1992) provide a detailed discussion about the use of between and within subject design in accounting research.
Analysis of effect sizes were also used to compare the results of this study (especially regarding hypothesis one) to that of Chow and Haddad (1991). Effect sizes indicate the extent to which the photo novo is present in the population, or the degree to which the null hypothesis is false (Coper and Hedges, 1994). Rosenthal and Rosnow (1994) suggest the use of effect sizes to compare two or more studies to check whether the studies are in agreement in the direction and size of the effect. The effect sizes are measured using the 'r' measure suggested by Rosenthal and Rosnow, and the comparison was conducted based on the Fisher z statistic.

**Measurement of the Dependent Variable: Agent Risk Selection**

The dependent variable agent risk selection refers to the degree to which agents select low or high risk investments on a single continuous measure: the degree of operating leverage (DOL) of the investments chosen by the subjects in the investment selection decision. DOL is the extent to which an investment project uses fixed cost compared to variable cost (Garrison, 1988). The higher the DOL, the higher the fixed cost of a project. A high DOL project is considered riskier than a low DOL project because the high DOL project's net income fluctuates more than that of the low DOL project (Chow and Haddad, 1993). DOL is also a determinant of market beta (Kline and Lipka, 1981; Huffman, 1989). Further, DOL is an important variable in new manufacturing technology investment that has high fixed cost (Kaplan and Atkinson, 1989).

The number of investment alternatives that are available to the subjects in the experiment depends on the subjects' effort decision and an actual state of nature. The subjects may decide to exert effort in the range of 3 to 5.50 in increments of 0.25 (i.e., 2.25, 2.50, 2.75, 3.00). The number of investment alternatives actually found range from four to the number of alternative investments searched. Further, the associated DOLs of the alternative investments found vary in the range of 2 to 5.50 in increments of 0.25 (i.e., 2.25, 2.50, 2.75, 3.00). This range is comparable to that used by Chow and Haddad (1991) and is comparable to many industry DOLs.

**Measurement of the Independent Variables**

**Contract type**

This study examines the effect of contract type, i.e., relative performance evaluation (RPE) and profit sharing (PS) contracts on agent effort and risk selection. RPE and PS are measured using the following compensation contracts:

\[
\begin{align*}
& m_t = 25000 + 25\% (X_t - X_i) \\
& m_t \leq 50000 \\
& m_t = 25000 + 25\% (X_t - X_i) \\
& m_t \leq 50000
\end{align*}
\]

where,

- \(m_t\) and \(m_t\) are the total compensation for RPE and PS subjects respectively,
- \(X_t\) is agent t's net income,
- \(X_i\) is the average of agent i's compensation group,
- \(X\) is a preset standard which is the expected value of $n$.  

The mechanics of the computations of effect sizes and the comparison of the effect sizes using Fisher z score can be found in Rosenthal and Rosnow (1991) and Rosenthal (1991).  

[1]
The single task situation was operationallyized by providing subjects with a preselected set of investment opportunities from which they had to make an investment selection. The number of investment opportunities available to the single task subjects were matched from the opportunities found by the dual task subjects, for comparability to the dual task experiment. This scenario eliminates the induced moral hazard problem and makes the risk-reversal trade off the only problem faced by the agents.

Feedback sign

Feedback was manipulated by telling the subjects their prior period's performance. Subjects assigned to negative (positive) feedback treatment were told that they did not (did) perform well in the previous period in that their division net income was below (above) the standard. RPE subjects were told if their decisions in the previous period resulted in net income above (negative feedback) or below (positive feedback) a preset standard net income. The relevance of the use of a preset standard in practice can be found in Merchant (1989).

For RPE subjects, they were told whether their decisions in the previous period resulted in net income above (positive feedback) or below (negative feedback) the group's average net income. Payne et al. (1980, 1981) provide justification for the use of the group average as meaningful feedback and framing for managers. They documented the results of an experiment where managers react to the average profits of their group.

Administration of the Experiment

The subjects were recruited from graduate business students in accounting.
finance and management courses. The experiments were conducted in a computer laboratory classroom. The potential subjects were told by the experimenter about the investment game (with actual cash prizes) the subjects would do in the experiment, the estimated time needed, the schedule and the location of the experiment. The subjects were also told that their participation was voluntary and confidential.

The experiments were conducted in fifteen sections. The subjects were assigned randomly among the treatments. Most of the RPE subjects were assigned to groups that consisted of four members. These groups were used to facilitate the measurement of each RPE subject's performance that was determined based upon the group average performance.

The experimental procedure

The experiments used the following procedure. First, the subjects received a handout that explained the task environment, the investment opportunity to the dual task subjects should find, the concept of degree of operating leverage (DOL), the experimental compensation, and the incentives the participants could get through the paywheel in the experiment.

Second, after the subjects understood the task, the concept of DOL and their incentives, they were asked to practice. They were permitted to practice for two times. This practice case allowed the subjects to familiarize themselves with the use of the computerized procedures in the experiment and the process of the investment game. After the practice session, the subjects were asked to answer some questions to check their understanding of the experimental tasks.

At the third step, the subjects performed the actual experiment by making the effort and risky investment decisions. The actual experiments started with the subjects receiving feedback about their performance in a pre-exposure period. Having received the feedback, the dual task subjects were asked to make an effort and a risk level selection and the single task subjects were asked to make a risk level selection only. Actual performance was determined by the effort and the risk selection decisions as well as actual rate of return that was manipulated using a computerized randomization to resemble a high uncertainty situation (explained below).

After the subjects selected an investment, the computer reported performance (not income) and the hypothetical compensation that affect the subject probability of winning in the lottery. The lottery was used to determine the subjects' actual incentives for participating in the experiment (the detail of the lottery is explained below). Upon completion of the experiment, the subjects were asked to fill out the exit questionnaire, then the drawing for the lottery took place, and the subjects were compensated based on the result of the lottery. The procedures were tested first in a pilot study using a similar process. The procedures and protocols of the experiments were also reviewed and certi—

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The pilot study was conducted involving eight graduate, seven undergraduate and one non-accredited students. The pilot check of the feedback manipulation, contract mechanics and the treatments were effective and understandable to the subjects. The subjects in the pilot study were asked to do the same task as above as the actual experiment, and were asked whether they understood the instructions and experimental tasks and expected instructions that were presented by the subjects to understand the instructions were reviewed.

The subjects' incentives

Actual incentives are determined using the Eng et al. (1986) method that induces risk behavior in experimental subjects. In this experiment the subjects are induced to exhibit risk averse behavior and to maximize their net utility by relating their actual incentives with a utility function of salary U(m) and disutility function of effort V(h):

\[
U = 473.47 - 473.47e^{-0.25h/30} \quad (13)
\]

\[
V = 0.62h \quad (14)
\]

Consistent with the agent risk averse assumption of principal agent theory, the concave utility and convex disutility functions (equations 13 and 14) induce risk and effort averse behavior in the subjects.

The procedure is also consistent with previous studies (Feder 1982, Kirby, 1992). The disutility function of effort was applied only to dual risk subjects who had effort level choices. The single task subjects whose only task was to make an investment choice were not induced with effort aversion because investment selection has no coax in this experiment (Dosi and Sapienza, 1987; Dye, 1992).

Eng et al. method converted the experimental point outcomes to a lottery with a particular probability of winning a preferred dollar-dominated prize (e.g., $10), and a residual probability of winning a less preferred dollar-dominated prize (e.g., $5). The conversion was done by averaging the possible point outcomes in the experiment (after the circumstances of the prize were according to the risk averse utility and effort aversion disutility functions (equations 13 and 14)). The wheel was then used to determine whether the subjects won prize e.g., by spinning the wheel spinners. If the spinner stopped in the area between 0 and the number of points the subjects had received, they won the preferred prize; otherwise they won the less preferred prize.

The manipulation of environmental uncertainty

All the subjects in all treatments faced the high uncertainty environment. Feder (1982) and Chow and Haddad (1991) have documented the significant effects of high environmental uncertainty on agent effort and risk selection respectively in agency settings. The high environmental uncertainty was manipulated following a procedure used by Chow and Haddad (1991) and Kirby (1991). This study used a computerized process to simplify the experimental procedure and to save time.

Consistent with equation 8, the minimum effort was set at five investment searches and the maximum was set at fifteen. As explained above, (so the measurement of effort), the subjects were allowed to select an effort level ranging

\footnote{The subjects may be motivated to perform in the experiment by viewing their performance directly to cash. However, since the performance is economically related to the subjects' actions, the subjects' actions are also influenced by their experience of ordering for incentives. In this setting, Eng et al.'s method can be used to control for the subjects' lag attitudes. Siroh and Cooper (1990) suggest that the risk environment may not be effective especially when the experimental task is complex. Point experiment manipulation checks are used in this study, as suggested by Siroh and Cooper (1990), to test the effectiveness of the risk environment.}
Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Feedback</th>
<th>Oral Task</th>
<th>Single Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Feedback</td>
<td>Feedback</td>
<td>Feedback</td>
<td>Feedback</td>
</tr>
<tr>
<td>n = 17</td>
<td>n = 11</td>
<td>n = 11</td>
<td>n = 11</td>
</tr>
<tr>
<td>R = .79</td>
<td>R = 3.07</td>
<td>R = .53</td>
<td>R = .52</td>
</tr>
<tr>
<td>df = 49</td>
<td>df = .83</td>
<td>df = .13</td>
<td>df = .34</td>
</tr>
<tr>
<td>Wₐ = .89</td>
<td>Wₐ = .89</td>
<td>Wₐ = .93</td>
<td>Wₐ = .92</td>
</tr>
<tr>
<td>z = .12</td>
<td>(z = .15)</td>
<td>(z = .63)</td>
<td>(z = .39)</td>
</tr>
</tbody>
</table>

Notes:
- E = Average (unmoderated) effort score
- R = Average (moderated) score for risk selection
- Wₐ = The Wild-Shapiro statistic for risk selection score

Hardy's F test for effect: ratio of the highest to the lowest variances = .36, F max = 5.67 (df = 4, 11).

Hardy's F test for risk: ratio of the highest to the lowest variances = 3.31, F max = 7.87 (df = 8, 11).

From five to fifteen. The actual minimum number of investment opportunities actually listed was set at four, while the actual maximum number would be equal to the number of investment opportunities searched. Thus, if a fifteen level was chosen, the possible outcomes were 4, 5, ..., 15, with each outcome equiprobable (8.3% in this case). The outcomes could never exceed the chosen level of effort.

In the single task environment, only investment selection decisions were made. The subjects were provided with the investment project opportunities that resulted from the randomization process and effort decision of the dual task subjects. This process was conducted to maintain the comparability of the response scale of the single task to dual task groups. After subjects decided their investment project selection, the computer determined the net income based upon the risk level selected and randomized actual state of nature. The states of nature range from 0.5 (poor economic conditions) to 1.5 (good economic condition) in increments of 0.1, and each possibility had the same chance (i.e., 9.9%) of occurrence.

Results

There were 97 graduate business students who participated in the experiments, 49 of which were assigned to dual task groups and 48 were assigned to single task groups. All of the 46 dual task subjects answered correctly the manipulation check regarding effort aversion. However, four dual task and two single task subjects failed the risk aversion manipulation check. Thus, the final samples are 95 subjects.

The subjects consist of 43 percent male and 57 percent female. The subjects' major was: accounting (22%), finance (22%), marketing (20%), management (18%), and others (17%). The subjects' work experiences range from 0 to 9 years. The average is 4.2 years. Table 1 presents
the number of subjects, average (aggregated) response scores and the distribution characteristics (normality) of the data regarding the dependent variable (risk selection) using the Wilk-Shapiro test for each experimental group. The descriptive statistics indicate that subjects in the single task environment groups generally selected higher levels of risk than those selected by subjects in the dual task groups. 

The lowest risk is selected by the dual task, PS and positive feedback group (3.79), whereas the highest risk is selected by the dual task, KPE and negative feedback group (4.52). The latter is higher than that of the similar group in single task environment (4.38).

ANOVA analysis assumes that the data are normally distributed and homoscedastic. The Wilk-Shapiro test is used to test if the dependent variables in each cell are normally distributed, while Hartley's "F" test is used to indicate if the variances are homogeneous (Kirk, 1982; Koppell, 1991). The Wilk-Shapiro's W statistic across the groups and the Hartley's "F" statistic indicate that the data meet the normality and homoscedasticity assumption, respectively (Table 1).

The Wilk-Shapiro W statistic can be used to test the normality assumption with small samples. A W score close to 1 indicates that the null hypothesis that a sample is derived from a normally distributed population can not be rejected. Hartley's "F" test, which can be used to test for homoscedasticity assumption is conducted by comparing the ratio of the highest and lowest variances among the cells to the F value for Fmax table. The degrees of freedom are p (the number of all variances) and n - 1 (the number of observations in each cell minus one). The ratio larger than the value at the Fmax table (3.76 < 5.67 and 3.35 < 7.87 for effort and risk selection, respectively), meaning that the null hypothesis of homogeneous variances can not be rejected.

The results of the manipulation checks indicate that the instructions were perceived as moderately easy to understand by the subjects. The mean rating on the degree of difficulty is 5.77 out of 1 (very difficult) to 7 (easy range). The subjects also felt that there was not much pressure in performing the experimental tasks. The response to questions about the subjects' perception on feedback and contracts indicate that the manipulations of feedback and contract types were effective. The subjects generally agreed that information about previous performance affected their subsequent decisions. The average score was 5.44 out of 1 (strongly disagree) to 7 (strongly agree) scale. The subjects completed the experimental tasks including the practice section in about 20 minutes.

The subjects' perceptions about the importance of competing was significantly different (t = 3.75, p < 0.001) between subjects with the relative performance evaluation contracts (4.20) from that of subjects with the profit sharing contracts (3.17). However, the KPE subject score of 4.20 out of 1 (strongly disagree) to 7 (strongly agree) range indicates that they do not strongly agree that competing with other managers was important. Finally, the manipulation checks also indicate that the subjects understand that as the salary increases, the probability of winning the lottery increases at a decreasing rate. The average score is 6.5 out of 1 (strongly disagree) to 7 (strongly agree).

Testing the homogeneity of variances using the Hartley-Ross statistic provides a similar result.
Tests of Hypotheses

The effects of contract type, task environment and feedback sign on agent risk selection are examined using ANOVA. The results are presented in Table 2. Tests of hypothesis 1 indicate that the effect of contract types on agents' risk selection is significant ($F_{4,44} = 9.12, p = 0.003$). The comparison of means between PS agents and RPS agents indicates that the direction is as predicted (Table 3). The mean of risk levels for RPS agents (4.00) is higher than that for PS agents (3.35) and is highly significant ($t_{21} = 3.01, p$ one-tailed = 0.002). However, since there is a significant interaction effect of contract types and task environments, the contract type and task environment can not be interpreted independently (see discussion below).

Tests of hypothesis 2 examine if the task environments (single vs. dual task) affect agents' risk selection. As expected, the result provides support for the hypothesis that single task agents are more risk seeking than dual task agents (Table 2, $F_{4,44} = 3.40, p = 0.06$). The comparison of means in Table 3 shows that the average levels of risk taken by single task and dual

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Independent variable</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contract type</td>
<td>9.71</td>
<td>1</td>
<td>9.12</td>
<td>.003</td>
</tr>
<tr>
<td>2</td>
<td>Task environment</td>
<td>3.62</td>
<td>1</td>
<td>3.40</td>
<td>.069</td>
</tr>
<tr>
<td>3</td>
<td>Contract type by task environment</td>
<td>4.38</td>
<td>1</td>
<td>4.11</td>
<td>.045</td>
</tr>
<tr>
<td>4</td>
<td>Feedback sign</td>
<td>8.40</td>
<td>1</td>
<td>7.89</td>
<td>.006</td>
</tr>
<tr>
<td>5</td>
<td>Contract type by feedback sign</td>
<td>2.13</td>
<td>1</td>
<td>2.00</td>
<td>.160</td>
</tr>
<tr>
<td></td>
<td>Task environment by feedback sign</td>
<td>.06</td>
<td>1</td>
<td>.06</td>
<td>.808</td>
</tr>
<tr>
<td></td>
<td>Contract type by task environment by feedback sign</td>
<td>.14</td>
<td>1</td>
<td>.13</td>
<td>.719</td>
</tr>
<tr>
<td></td>
<td>Model</td>
<td>28.83</td>
<td>7</td>
<td>3.87</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>88.38</td>
<td>83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = 0.25$
Task agents are 3.88 and 3.48 respectively. The difference is significant ($t_{\text{one-tailed}} = 1.84, p = 0.034$).

The interaction effect of contract type and task environment on agent risk selection is significant (Table 2, $F_{\text{contract}} = 4.11, p = 0.046$), and supports hypothesis 3. Because the interaction of contract type and agent risk selection is significant, the main effects of the variables cannot be interpreted independently (Krippel, 1991). The effect of one variable depends on the level of the other. Comparisons of means in Table 3 show that the effects of task environment is higher under PS than that under RPE. Figure 5 illustrates this. PS subjects in single task groups select risk level (3.77) that is significantly higher ($p = 0.033$) than that selected by PS subjects in dual task groups (3.95). For RPE subjects, risk levels of single task groups (3.98) is not significantly different ($p = 0.448$) from those of dual task groups (4.02).

The interaction between task environment and contract type can also be examined from the contract type perspective. The difference in risk levels between RPE (4.02) and PS subjects (2.93) is significant only when subjects are in the dual task environment (Table 3, $F_{\text{contract}} = 2.51, p = 0.016$). In single task environments, the difference of risk levels between RPE (3.98) and PS subjects (3.77) is not significant (Table 3, $t_{\text{one-tailed}} = 0.71, p = 0.241$).

### Table 3: Comparison of Means of Agent Risk Selection by Contract Types and Task Environment

<table>
<thead>
<tr>
<th>Contract Type</th>
<th>Task Environment</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>t-Test of Differences</th>
<th>p-Values (Hypotheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPE</td>
<td></td>
<td>3.98</td>
<td>2.91</td>
<td>1.84</td>
<td>0.034</td>
</tr>
<tr>
<td>PS</td>
<td></td>
<td>3.77</td>
<td>3.35</td>
<td>2.75</td>
<td>0.046</td>
</tr>
<tr>
<td>Column means</td>
<td></td>
<td>3.88</td>
<td>3.41</td>
<td>1.84</td>
<td>0.034</td>
</tr>
<tr>
<td>Task Environment</td>
<td>Dual Task</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPE</td>
<td></td>
<td>4.02</td>
<td>3.55</td>
<td>0.31</td>
<td>0.71</td>
</tr>
<tr>
<td>PS</td>
<td></td>
<td>3.77</td>
<td>.000</td>
<td>0.002</td>
<td></td>
</tr>
</tbody>
</table>

* One-tailed test

PS: Profit sharing

RPE: Relative performance evaluation

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The results indicate that Chow and Haddad's (1991) finding that RPE contracts result in highest agent risk selections than PS contracts can only be "replicated" in dual task, but not in single task situations. The effect size of RPE in dual task situations found in this study (r = .48) is comparable to the effect of RPE (without considering the task environment) found in Chow and Haddad's (r = .63) with Z = 2.41, p one-tailed = .019. For the single task situations, the study found a significantly smaller effect size (r = .17) than that found in Chow and Haddad's (r = .63) with Z = -30, p one-tailed = .008.

An interpretation of this result is that the RPE contract may reduce the mental hazard and agent risk aversion that exist in dual task environments. Under the PS-contract and the dual task situation, agents tend to be risk averse to prevent the supervisor's perception that a bad outcome (from a risky project) is a result of low agent effort. Since in RPE contracts agent performance is compared to the poor average, supervisors may not perceive that a bad outcome is a result of a low effort. This is because the poor average can reveal information about common uncertainty for principals.

The effect of feedback signs on agent risk selection is significant (Table 3; F = 7.89, p = 0.006), supporting hypothesis 4. The interaction effect of contract types and feedback signs on agent risk selection is not significant (Table 3; F = 2.00, p = 0.160) at conventional levels. Thus, hypothesis 5 is not supported, and feedback
signs affect agent risk selection independent of the types of contracts. In summary, this study found some empirical, experimental evidence about the effects of contract types, feedback signs and task environment on agent risk selection. Except for the interaction between contract type and task environment, the interaction effects are not significant.

Conclusion

The main effects of contract types, task environments, and feedback signs on agent risk selection are significant (Table 2). Agents who have an RFE contract, a single task, or receive negative feedback demonstrate higher risk selections than do agents with a FS contract, dual tasks, or who receive a positive feedback, respectively (Table 2 and 3). The significant effect of contract types is consistent with Chow and Sudduth (1991). The effect of task environment (dual vs. single task) is consistent with and provides empirical evidence for Zemeld and Sappington’s (1997) proposition. The significant effect of feedback signs on risk selection indicates the complementarity of agency and prospect theory: even when agents are risk averse, their risk preferences still vary according to the feedback signs.

The interaction effect between contract type and task environment is significant, but the other interactions are not significant (Table 2). The significant interaction between contract types and task environment means that the two independent variables must be examined jointly. Looking at the cell means of agents’ risk selection according to the contract types and task environment (Table 3) indicates that the task environment factor is effective only when the contract type is profit sharing (FS). Under the FS contract, single task agents choose a higher level of risk selection than dual task agents. The evidence also indicates that RFE contracts may reduce agent risk aversion resulting from the dual task environment.

The interaction of contract types and feedback signs is not significant. One potential reason for this result is that the feedback manipulation is not effective enough to be perceived differently by RFE from that of FS subjects. Both RFE and FS subjects were provided with the feedback that their performances were above (positive) or below (negative) the average of the RFE group or the preset standard for FS. This manipulation may drive the result. Another reason is that the use of a between subject design in the experiment can reduce the power of the test of interaction (Kirk, 1982).

An implication of the results in practice is that RFE contracts can be used to induce agent risk behavior. Superiors may also use RFE contracts to reduce agency costs in dual task and multiagent environments. However, some other factors are worth noting in interpreting this result and its implication. The first is about individual risk attitudes. Previous studies indicate that individual risk behavior is a dimension of personality variables and may affect individual decisions (Young, 1985). Although this study applied a procedure to induce risk aversion (i.e., the Berg et al. method), individual risk attitudes may affect the effectiveness of the procedure. In addition, Seth and Cooper (1990) suggest that there is no procedure to guarantee that the induction of risk behavior is effective. Thus, this study may be extended by considering the effects of risk attitudes as a dimension of a personality variable.

Second, the assumptions regarding agent behavior (i.e., individual rationality...
The Effect of Contract Type, Feedback and Task Environment (IR), information selection (IS) and action selection (AS) are manipulated (explicitly) in the experimental procedures. However, similar to the manipulation of risk attitude, there is no guarantee that all the procedures are effective.

Third, care should be taken with respect to the external validity of the findings. Feedback is a complex phenomenon. The psychology and organizational behavior literature indicates that the effect of feedback on individual behavior may depend on contextual factors, such as sources, types, consistency and frequency of feedback messages (Iyengar et al., 1978; Lucht and Eggleston, 1991).

Iyengar, this study examines its objectives in these respects: First, empirical evidence was provided on Demski and Steppingstone's (1987) proposition that single task agents are more risk seeking than double task agents. Second, the effects of feedback types persist in an agency setting, but at smaller sites than those in general social setting. Third, prospect theory complements agency theory in that even if agents are risk averse, their risk selections still vary depending upon feedback types.

Finally, while the works of Frederickson (1992) and Chew and Hagedoorn (1991) are replicated, this study finds that contract types interact with task environment affecting risk selection. Contract type affects risk selection in dual task, but not in single task environments. Since RPE contracts have been found to be used in actual practice (Mayer, 1987; Merchant, 1989, this finding provide some more explanation and contingencies about the effectiveness of the RPE.

There are four limitations worth noting. First, this study uses certain types of tasks and standard-based pay contracts and parameter values for performance evaluation. Changing these types of contracts and parameter values may change individual responses. Second, managers are evaluated not only for determining their pay but also for other purposes such as promotion and training which are not considered in this study (Huber et al., 1987). These other types of evaluation may also affect manager effort and risk selection. Third, subject responses in a single period decision and single or dual task situation in the experiment may not resemble actual managerial responses in multiperiod and multitask situations.

Fourth, the average RPE subject response scores on the question about the importance of cooperation indicate an indifferent position (4.30). Furthermore, the levels of pressure also indicate a low score (1.83). These may indicate that the subjects may not sufficiently internalize the manipulation of RPE contract.

Principal-agent theory has been extended analytically to include factors such as job design and technology. Hammer (1995) suggests that different job designs and technology affect agent effort and productivity. Hammer showed that the cooperative contract approach is effective for enhancing agent effort and productivity in a multiagent high technology manufacturing setting relative to that of an assembly line approach. Hammer's analysis is consistent with that of Young et al. (1993) and Itoh (1992). The current study defines the dual task environment as two sequential decision tasks. This study should be extended to other job situations such as described in Hammer (1995).

Replications, experiments using professionals, and case studies examining the practice in actual organizations can be conducted to extend this study. Kapp and Alkinoos (1989) suggest that case studies are important to increase the relevance of management accounting stu.
References


