

The Impact of Risk Aversion and Stress on the Incentive Effect of Performance Pay

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Research Background 1

- Role of financial incentives in affecting behavior is a central theme in economics.
- Traditional View: Monetary incentives represent a dominant and effective motivator of human behavior.
 - Performance-contingent pay can be an effective incentive device to induce desired performance and to resolve principal-agent problems. (e.g., Coase, 1937; Jensen & Meckling, 1976, Williamsom, 1975).

Research Background 2

- Behavioral Economics and Social Psychology
 - Motivational “Crowding-Out” (e.g., Deci & Ryan, 1985; Gneezy & Rustichini, 2000; lit review in Frey and Jegen, 2001).
 - “Choking-under-Pressure” (e.g., Baumeister, 1984; Baumeister & Showers, 1986).
 - “Risk as Feelings” (Loewenstein, Hsee, Weber & Welch, 2001).

Empirical Evidence

- A considerable number of studies show that monetary incentives are effective at improving performance.
- But some indicate no effect on performance.
- Others demonstrate circumstances under which incentives can hinder performance.

Bonner et al. (2000), Camerer & Hogarth (1999), and Jenkins et al. (1998) all review this literature.

Literature Gap

- All of these empirical studies on incentive effects are primarily concerned with the *average* effect of incentives on performance.
- Whether and to what extent *systematic individual differences* may also have an important impact on the *effectiveness of financial incentives* is not explored.

Risk Attitudes and Individual Decisions

- We examine whether the effectiveness of financial incentives may be affected by individual differences in attitudes toward financial risk and uncertainty.
- Guiso & Paiella (2004) use Italian household survey data to show how risk attitudes affect many household decisions such as level of education, occupational choice, moving decisions, exposure to chronic diseases, and of course portfolio decisions.

Theory 1

- We compare productivity under two schemes:
 1. A **fixed-pay** compensation scheme (*fs*) where no performance-contingent incentives are offered, and all risk is borne by the firm.
 2. A **performance-contingent** piece-rate scheme (*pfpr*), where risk is borne by the employees.
- We argue that risk attitudes may affect changes in productivity under *pfpr* in two ways:
 1. A direct **rational** impact on productivity when productivity-enhancing strategies (e.g. effort) are positively correlated with risk.
 2. An **affective** or **emotional** impact on hindrance stress levels and hence on the extent of choking under pressure.

Theory 2

- Expected return may be positively correlated with risk under a piece rate.
 - e.g., suppose $E(y) = p \cdot n$ where n = number of attempts and p = probability of success.
 - $\sigma^2(y) = p \cdot (1-p) \cdot n$ if p does not change with n .
- For a person who is more risk-averse, *ceteris paribus*, taking on more risk through the exertion of more effort involves greater disutility of effort. Hence, such a person may sacrifice some expected return to reduce risk by exerting less effort.

Theory 3

- However, this is not necessarily the case because a more risk-averse person may also feel “poorer” at a given expected return and risk level than a less risk-averse person, and thus choose less leisure and hence more effort.
- First “substitution-like” effect dominates second “income-like effect unambiguously with mean-variance assumptions (quadratic utility), but more general expected utility result cannot be unambiguously signed.
- **Motivation for experiment.**

Theory 4

- In addition stress under performance pressure from *pfpr* may cause choking, thus hindering performance.
- *fs* involves no pay uncertainty so risk is not an issue and choking likelihood is less than under *pfpr*.
- Under *fs* we expect people to produce some output either because they enjoy the work, or want to reciprocate for their salary, or are inclined to obey instructions.

Hypothesis 1

- The effectiveness of **performance-contingent incentives** at improving performance is **inversely related** to individual levels of **risk aversion**.

Study One

- **Participants:** 115 (71 men and 44 women with an average age of 20.9 years) at QUT in Australia.
- **Task:** anagram word-creation game, e.g., SATERDU.
- **Treatments:** within-person ABAB
 - A is *fs* at \$2.20 per round.
 - while B is *pfpr* at \$0.20 per word.
 - Four three-minute rounds: *fs, pfpr, fs, pfpr* after several rounds of practice.

	Option A	Option B	YOUR CHOICE
Decision 1	\$4.40 if throw of die is 1 \$3.52 if throw of die is 2-10	\$8.47 if throw of die is 1 \$0.22 if throw of die is 2-10	
Decision 2	\$4.40 if throw of die is 1-2 \$3.52 if throw of die is 3-10	\$8.47 if throw of die is 1-2 \$0.22 if throw of die is 3-10	
Decision 3	\$4.40 if throw of die is 1-3 \$3.52 if throw of die is 4-10	\$8.47 if throw of die is 1-3 \$0.22 if throw of die is 4-10	
Decision 4	\$4.40 if throw of die is 1-4 \$3.52 if throw of die is 5-10	\$8.47 if throw of die is 1-4 \$0.22 if throw of die is 5-10	
Decision 5	\$4.40 if throw of die is 1-5 \$3.52 if throw of die is 6-10	\$8.47 if throw of die is 1-5 \$0.22 if throw of die is 6-10	
Decision 6	\$4.40 if throw of die is 1-6 \$3.52 if throw of die is 7-10	\$8.47 if throw of die is 1-6 \$0.22 if throw of die is 7-10	
Decision 7	\$4.40 if throw of die is 1-7 \$3.52 if throw of die is 8-10	\$8.47 if throw of die is 1-7 \$0.22 if throw of die is 8-10	
Decision 8	\$4.40 if throw of die is 1-8 \$3.52 if throw of die is 9-10	\$8.47 if throw of die is 1-8 \$0.22 if throw of die is 9-10	
Decision 9	\$4.40 if throw of die is 1-9 \$3.52 if throw of die is 10	\$8.47 if throw of die is 1-9 \$0.22 if throw of die is 10	
Decision 10	\$4.40 if throw of die is 1-10	\$8.47 if throw of die is 1-10	

RA measure

Data Summary

- Performance was 21.12 words over two rounds under *pfp* and 18.86 words over two rounds under *fs*. Thus, improvement was 2.26 words and significant ($df = 114, p < 0.001$).
- Participants were quite risk-averse with an average of 6.77 safe choices.

Main Result and Implication

- We found a significant and inverse relationship between productivity improvement and the level of risk aversion ($\beta = -0.223, p = .017$), corroborating H1.
 - Thus, performance pay was a less effective motivator for more risk-averse individuals as predicted.
 - In fact, 29 out of 115 participants, accounting for 25.2% of our sample, actually experienced a decline in productivity in the *pfp* rounds.

Study 2 – To Achieve Two Extra Goals

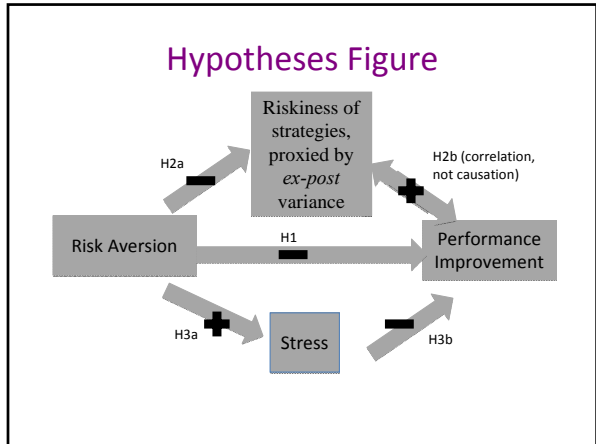
- To examine the robustness of our Study-1 result, i.e. H1.
 - A different task and a different population
- To examine the relative importance of the two proposed mechanisms and their implications, summarized by Hypotheses 2 and 3.

Hypothesis 2

- (a) More risk-averse individuals choose more cautious, less risky work strategies, e.g. less effort, leading to a lower *ex-post* variance in individual performance across rounds in *pfp*, but not in *fs*.
- (b) Since these more cautious strategies involve a sacrifice in productivity, this in turn leads to a positive correlation between the increase (decrease) in variance across rounds and the improvement (decline) in performance.

Hypothesis 3

- (a) More risk-averse individuals report a greater difference in stress levels between *pfp* and *fs*.
- (b) The difference in stress levels partially mediates the inverse effect of risk aversion on productivity improvement.



Study 2

- **Participants:** 60 (36 men and 24 women with an average age of 19.3 years) at U. of Guelph in Canada.
- **Task:** adding up sets of five double-digit integers, e.g. 26, 35, 78, 92, 14.
- **Treatments:** within-person BABABABA
 - A is *fs* at \$2.00 per round.
 - while B is *pf* at \$0.25 per word.
- **Stress Measure:** a self-report Likert scale (1–5) measure to indicate how stressful subjects found working under *fs* and *pf* schemes.

Data Summary

- Performance over four rounds was 30.02 problems under *pf* and 26.84 under *fs*. Thus, improvement was 3.18 and significant (df=59, $p < 0.001$).
- 28 participants (28.4%) in fact experienced a decline in productivity in the *pf* rounds.
- Participants were quite risk-averse with an average of 5.72 safe choices.

Study 2: Means, Standard Deviations, and Correlations

	Mean	SD	1	2	3	4	5	6	7	8	9
1. <i>pf</i> Output	30.07	9.39									
2. <i>fs</i> Output	26.68	8.97	0.72***								
3. <i>pf</i> - <i>fs</i> Output Improvement	3.18	6.71	0.42**	-0.32*							
4. <i>pf</i> - <i>fs</i> Output Variance Diff.	0.02	1.74	0.24	0.03	0.30*						
5. <i>pf</i> Effort	35.07	9.94	0.94***	0.74***	0.31*	0.26**					
6. <i>pf</i> Success Ratio	0.86	0.09	0.38**	0.13	0.36**	0.003	-0.07				
7. Risk Aversion	5.72	1.81	-0.60***	-0.14	-0.66***	-0.40**	-0.59***	-0.13			
8. Stress	2.20	1.64	-0.30*	0.01	-0.40***	-0.24	-0.29*	-0.14	0.31*		
9. Male Dummy (Male=1)	0.40	0.49	0.03	-0.20	0.31*	-0.06	-0.05	0.23	-0.02	0.02	
10. Born-Abroad Dummy (Born-Abroad=1)	0.28	0.46	0.29*	0.43**	-0.18	-0.05	-0.24	0.20	-0.05	-0.19	-0.14

N = 60. *** are significant at $p < .001$; ** are significant at $p < .01$; and * are significant at $p < .05$ (two-tail test)

The Effects of Risk Aversion on Productivity Improvement and Variance

	Productivity Improvement	<i>pf</i> Performance Variance	<i>fs</i> Performance Variance	<i>pf</i> - <i>fs</i> Performance Diff.
Constant	2.355 (0.011)	1.693 (0.000)	1.667 (0.000)	0.027 (0.899)
Male Dummy	3.722 (0.004)			
Born-Abroad Dummy	-2.275 (0.098)			
Centred Risk Aversion	-2.428 (0.000)	-0.232 (0.020)	0.155 (0.183)	-0.387 (0.001)
Adjusted R ²	0.516	0.074	0.014	0.148

Result 1: Productivity improvement is once again inversely and significantly related to risk aversion ($b = -2.428, p = 0.00$), supporting H1.

Result 2: The *ex-post* performance variance, a proxy for the riskiness of the chosen strategy, has significant inverse relationship with risk aversion in the *pf* data ($p = 0.02$) but not in the *fs* data ($p = 0.183$).

Result 3: The variance difference between *pf* and *fs* has significant inverse relationship with risk aversion ($p = 0.001$), supporting H2a.

Study 2: The Correlation between *pf*-*fs* Variance Difference and Productivity Improvement and the Relationship between *pf*-*fs* Stress Difference and Risk Aversion

	Productivity Improvement	<i>pf</i> - <i>fs</i> Stress Diff.
Constant	1.360 (0.188)	2.198 (0.000)
Male Dummy	4.485 (0.007)	
Born-Abroad Dummy	Dropped	
Centred Stress Difference		
<i>pf</i> - <i>fs</i> Variance Difference	1.220 (0.010)	
Centred Risk Aversion		0.280 (0.016)
Adjusted R ²	0.168	0.080

Result 4: Productivity improvement is positively correlated with variance difference ($p = 0.010$), supporting H2b.

Result 5: Stress Difference is positively related to risk aversion ($p = 0.016$), supporting H3a.

Study 2: The Effects of Risk Aversion and Stress on Productivity Improvement

	All Data (n=60)	All Data (n=60)	All Data (n=60)	Those who improved (n=39)	Those who didn't improve (n=21)	Logit Regression
Constant	2.355 (0.011)	2.461 (0.030)	2.941 (0.001)	5.343 (0.000)	-1.048 (0.132)	1.026 (0.072)
Male Dummy	3.722 (0.004)	3.978 (0.012)	3.765 (0.001)	2.260 (0.074)	1.585 (0.253)	1.697 (0.043)
Born-Abroad Dummy	-2.275 (0.098)	-3.067 (0.075)	-3.103 (0.015)	-1.702 (0.246)	-1.632 (0.171)	-1.764 (0.038)
Centred Stress	-1.834 (0.000)	-0.884 (0.019)	-0.220 (0.657)	-0.220 (0.657)	-1.124 (0.001)	-0.810 (0.013)
Centred Risk Aversion	-2.428 (0.000)	-2.293 (0.000)	-1.724 (0.000)	-1.724 (0.000)	-1.181 (0.009)	-0.807 (0.007)
Interaction			-0.407 (0.019)			
Adjusted R ²	0.516	0.268	0.610	0.382	0.572	

Result 6: Stress partially mediates the effect of risk aversion on productivity improvement, supporting H3b. Sobel test: Z=2.06, p=0.039.

Result 7: The interaction term is also significant (p=0.019) with a negative coefficient.

Result 8: Higher stress decreases the probability of productivity improvement. While RA is negative and significant for both subgroups, stress is significant only for those who did not improve.

Supplementary Analysis

- Recall $E(y)=p \cdot n$ where n=number of attempts and p=probability of success.
- Does effort (number of attempts) mediate the effect of risk aversion on *pfp* productivity as suggested in H2?
- Does stress affect *pfp* productivity through its effect on the number of attempts or its effect on the probability of success?

Study 2 Supplementary: The Effects of Risk Aversion and Stress on *pfp* Effort and Success Ratio

	<i>pfp</i> Effort	<i>pfp</i> Success Ratio	<i>pfp</i> Effort	<i>pfp</i> Success Ratio
Constant	33.76 (0.000)	0.823 (0.000)	35.07 (0.000)	0.82 (0.000)
Male Dummy	Dropped	0.048 (0.049)	Dropped	0.049 (0.046)
Born-Abroad Dummy	4.68 (0.04)	0.048 (0.074)	Dropped	0.045 (0.100)
Centred Risk Aversion	-3.16 (0.000)	-0.006 (0.361)		
Stress			-1.77 (0.023)	-0.006 (0.412)
Adjusted R ²	0.369	0.072	0.070	0.069

Result 9: Risk Aversion significantly affects number of attempts, but not the probability of success.

Result 10: Stress significantly affects number of attempts, but not the probability of success.

Study 2 Supplementary: The Effects of Risk Aversion and Effort on *pfp* Output

	<i>pfp</i> Output	<i>pfp</i> Output	<i>pfp</i> Output
Constant	28.571 (0.000)	-1.895 (0.207)	-0.372 (0.836)
Male Dummy	Dropped	1.729 (0.035)	1.668 (0.040)
Born-Abroad Dummy	5.352 (0.012)	1.545 (0.089)	1.696 (0.062)
Centred Risk Aversion	-3.05 (0.000)		-0.392 (0.145)
<i>pfp</i> Effort		0.879 (0.000)	0.835 (0.000)
Adjusted R ²	0.408	0.898	0.912

Result 11: Effortfully mediates the effect of risk aversion on *pfp* output. The Sobel test for significant mediation z=5.26, p=0.000.

CONCLUSIONS AND DISCUSSION 1

- Focusing on the role of **performance pay**, we examined the interrelations between **RA**, **choice of work strategy** (e.g. **effort/number of attempts**), **stress**, and the effect of financial incentives on **productivity**.
- Other studies have examined how individual attitudes toward risk influence how individuals sort themselves into different pay schemes (e.g. Cadsby, Song & Tapon, 2007).
- This is the first study in which individual attitudes toward risk have been linked with the strength of the motivation effect of performance pay at increasing productivity.

CONCLUSIONS AND DISCUSSION 2

Key findings

- More risk-averse people
 - rationally retreat from the risk inherent in *pfp* by choosing less risky work strategies such as a reduction in effort even though by doing so they may lower their expected performance
 - experience a greater increase in stress, which in turn affects performance of more risk-averse individuals

CONCLUSIONS AND DISCUSSION 3

- Response to incentives depends not only on context, but also on individual heterogeneity.
- Whether stress from performance-contingent pay hinders performance may depend on how much one dislikes financial uncertainty.
- More risk-averse employees are likely to be less responsive, unresponsive, or even respond in the wrong direction under performance-contingent pay.
- Different kinds of pay schemes may suit different people, and attitudes toward risk may be a critical factor in determining the best employee-compensation fit.

CONCLUSIONS AND DISCUSSION 4

- Is it best then to leave the choice of pay scheme up to the employee?
- Cadsby, Song, & Tapon (2007) show that both ability and risk-aversion affect whether people select *fs* and *pfp*. However, performance improvement under *pfp* is related to risk aversion, but not to ability.
- This implies that allowing people to self-select into compensation schemes will not generally result in people selecting the scheme in which they would be most productive.
- For example, a very skilled person who is quite risk-averse may maximize his/her earnings by selecting *pfp*, even though s/he might produce more under *fs*.