Contents

1 Introduction 1

2 The Basic Principal-Agent 3
2.1 Contractual Relationship Between a Principal and an Agent 6

3 Risk-Neutral Agent 9
3.1 Optimal Strategies for Risk-Neutral Agent 11
3.1.1 Sensitivity Analysis of the Optimal Strategy 15
3.1.2 The Second-Best Solution 16
3.1.3 Our Principal-Agent Game 17

4 Risk-Averse Agent 19
4.1 Optimal Strategies with a Weakly Risk-Averse Agent 23
4.1.1 Sensitivity Analysis of a Weakly Risk-Averse Agent's Optimal Strategy 33
4.1.2 Principal's Optimal Strategy 36
4.2 Optimal Strategies Given a Strongly Risk-Averse Agent 45
4.2.1 Sensitivity Analysis of a Strongly Risk-Averse Agent's Optimal Strategy 54
4.2.2 Principal's Optimal Strategy 56
4.3 Risk-Averse Agent: A Summary 60
4.3.1 Sensitivity Analysis of Optimal Strategies in High Revenue Industry 61
4.3.2 The Second-Best Solution in High Revenue Industry 63

5 Risk-Seeking Agent 65
5.1 Optimal Strategies for the Weakly Risk-Seeking Agent 68
5.1.1 Sensitivity Analysis of a Weakly Risk-Seeking Agent's Optimal Strategy 81
5.1.2 Principal's Optimal Strategy 83

5.2 Optimal Strategies for the Moderately Risk-Seeking Agent 89
5.2.1 Sensitivity Analysis of a Moderately Risk-Seeking Agent's Optimal Strategy 97
5.2.2 Principal's Optimal Strategy 99
5.3 Optimal Strategies for the Strongly Risk-Seeking Agent 102
5.4 Risk-Seeking Agent: A Summary 104

6 Summary 107
6.1 Interpreting Table 6.1 109

Acknowledgment 113

Appendix 115

References 125

Index 127

List of Figures

Fig. 3.1 Illustration of the forms of $u(\mu)$ 12
Fig. 3.2 Structure of the proof for Proposition 3.3 12
Fig. 3.3 Conditions when a risk-neutral agent accepts the contract 13
Fig. 3.4 Structure of the proof for Theorem 3.4 14
Fig. 3.5 Structure of the principal-agent extensive form game 18

Fig. 4.1 $\pi(\mu, w, p)$ as a function of $P(1)$ when $\eta = 1$ 20
Fig. 4.2 Illustration of the forms of $u(\mu)$ when $\eta \in (0, 3/5]$ 26
Fig. 4.3 Structure of the proof for Proposition 4.9 when $\eta \in (0, 3/5]$ 27
Fig. 4.4 Illustration of the forms of $u(\mu)$ when $\eta \in (3/5, 4/5)$ 30
Fig. 4.5 Structure of the proof for Proposition 4.9 when $\eta \in (3/5, 4/5)$ 31
Fig. 4.6 Conditions when a weakly risk-averse agent accepts the contract with $\eta = 0.6$ 33
Fig. 4.7 Structure of the proof for Proposition 4.18 40
Fig. 4.8 Structure of the proof for Theorem 4.19 and Proposition 4.20 44
Fig. 4.9 The value of $\tilde{\Pi}_P \equiv \Pi_P(w^*, p^* = p_{cu}; \mu^*) - \Pi_P(w^*, p^* = p_3; \mu^*)$ for $r \in (p_3, r_2)$ 46
Fig. 4.10 Illustration of the forms of $u(\mu)$ when $\eta \in [4/5, 1)$ 48
Fig. 4.11 Structure of the proof for Proposition 4.23 when $\eta \in [4/5, 1)$ 49
Fig. 4.12 Illustration of the forms of $u(\mu)$ when $\eta \geq 1$ 51
Fig. 4.13 Structure of the proof for Proposition 4.23 when $\eta \geq 1$ 52
Fig. 4.14 Conditions when a strongly risk-averse agent accepts the contract with $\eta = 2$ 54
Fig. 4.15 Structure of the proof for Theorem 4.27 58
Fig. 4.16 Conditions when a risk-neutral principal makes offers to a risk-averse agent 61

Fig. 5.1 $\pi(\mu, w, p)$ as a function of $P(1)$ when $\eta = -1$ 66
Fig. 5.2 Illustration of the forms of $u(\mu)$ when $\overline{\eta} \in (0, 3/4]$ 73
Fig. 5.3 Structure of the proof for Proposition 5.10 when $\overline{\eta} \in (0, 3/4]$ 74
Fig. 5.4 Illustration of the forms of $u(\mu)$ when $\overline{\eta} \in (3/4, 8/9)$ 76
Fig. 5.5 Structure of the proof for Proposition 5.10 when $\overline{\eta} \in (3/4, 8/9)$ .. 77

Fig. 5.6 Conditions when a weakly risk-seeking agent accepts the contract with $\overline{\eta} = 0.5$ 80
Fig. 5.7 Structure of the proof for Theorem 5.17 87
Fig. 5.8 Illustration of the forms of $u(\mu)$ when $\overline{\eta} \in [8/9, 1)$ 92
Fig. 5.9 Structure of the proof for Proposition 5.19 when $\overline{\eta} \in [8/9, 1)$ 93
Fig. 5.10 Illustration of the forms of $u(\mu)$ when $\overline{\eta} \in [1, 2)$ 95
Fig. 5.11 Structure of the proof for Proposition 5.19 when $\overline{\eta} \in [1, 2)$ 96
Fig. 5.12 Conditions when a moderately risk-seeking agent accepts the contract with $\overline{\eta} = 1$ 98
Fig. 5.13 Structure of the proof for Theorem 5.22 101
Fig. 5.14 Illustration of the forms of $u(\mu)$ when $\overline{\eta} \geq 2$ 103
Fig. 5.15 Structure of the proof for Proposition 5.24 when $\overline{\eta} \geq 2$ 103
Fig. 5.16 Conditions when a principal makes contract offers to a risk-seeking agent 105

List of Tables

Table 2.1 The variables of the model 5

Table 4.1 Indicators of the monotonicity and the concavity/convexity of function $u(\mu)$ in (4.3) 22

Table 5.1 Indicators of the monotonicity and the concavity/convexity of function $u(\mu)$ in (5.3) 69

Table 6.1 Summary of the optimal principal-agent contract formulas under exogenous conditions 110