Team Incentives and Reference-Dependent Preferences

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Abstract

This paper studies the two-person multi-agent moral hazard model where the agents have the expectation-based reference-dependent preferences developed by Kőszegi and Rabin (2006, 2007). We show that the optimal contract when the agents' loss aversion is modest, the optimal contract is based on team incentives. If the probability of success is small, the principal offers a positive wage unless both agents fails (joint performance evaluation). If the probability of success is large, the principal offers a positive wage unless the agent fails and the other agent succeeds (relative performance evaluation). Our result provides a new insight that team incentives serves as a risk-sharing device among agents.

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How to design team incentives has been one of the central themes of contract theory. The fact that teams have become increasingly popular seems to have highlighted the importance of this theme. The controversial issue of team incentives is that an incentive scheme should be based on whether relative performance evaluation (RPE), joint performance evaluation (JPE), or independent performance evaluation (IPE).

It is well known that incentives based on IPE are optimal in the simple moral hazard model with risk-averse multi-agents and no common shock. Holmstrom (1983), one of the seminal papers of this field, shows that RPE can be optimal if the performance measure includes a common noise factor because it reduces agents' risk exposure. Lazear and Rosen (1981) and Green and Stokey (1982) also study a tournament scheme, which is an extreme incentive scheme based on RPE, and showed its efficiency compared to IPE. While these studies illustrate the positive aspect of RPE, in addition to the collusion problem, RPE has a disadvantage; it discourages cooperation among agents, or even worse, gives incentives to sabotage. JPE could alleviate such negative effects of RPE. For example, Holmstrom and Milgrom (1990) and Itoh (1993) show that if agents coordinate their efforts and share risks in a Pareto-efficient way, then the optimal contract should be based on JPE. Also, Lazear (1989) demonstrates that JPE can be effective in the situation where sabotage is relevant. While these models are static, Che and Yoo (2001) and Kvaløy and Olsen (2006) analyze the repeated interactions among agents and show that there is a possibility that JPE is preferred

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to RPE even if it is not true in the static settings. These theoretical results of the efficiency of JPE rather than RPE may explain one empirical puzzle, pointed by Chiappori and Salanié (2003); they argue that firms do not seem to use RPE for executive compensations so often. Some empirical studies also show that team incentives based on JPE are frequently associated with increased productivity.[1]

Beyond the importance of cooperation or long-term interaction in teams, we focus on an important behavioral ingredient, loss aversion. We show that loss aversion drives the validity of team incentives based on JPE and RPE by incorporating agents with the expectation-based reference preferences. A notion of loss aversion is originally investigated by Kahneman and Tversky (1979), and substantially developed by Kőszegi and Rabin (2006, 2007, 2009). They define that a decision maker has a multi-dimensional "consumption utility," which is essentially same as an intrinsic (standard material) one, and "gain-loss utility," which is an extension of Kahneman and Tversky (1979)'s value function. One of the most prominent points of their formulation is that the decision maker's reference point is a recent rational expectation on her consumption utility, and hence a reference point is endogenously determined.

In this paper, we analyze multi-agent contracts with limited liabilities. We assume that agents are risk-neutral, but have the expectation-based reference dependent preferences à la Kőszegi and Rabin (2006, 2007). Thus, we define that each agent is loss-averse in both money dimension and effort cost dimension, and his reference point is a rational expectation (probabilistic belief) of his wage and effort.[2] We investigate how the agents' loss aversion affects their equilibrium behavior, and how it affects an optimal wage scheme.[3] Due to the loss aversion, the agents dislike their wage uncertainty. By this inclination, the agents are more willing to work by compensating their failure if the degree of loss aversion is substantial.

We show that the optimal wage scheme is based on team incentives when the agents' loss aversion is modest.[4] On the one hand, if the probability of success is small, the principal offers a positive wage unless both agents fails. Thus, the optimal wage schemes exhibits JPE. On the other hand, if the probability of success is large, the principal offers a positive wage unless the agent fails and the other agent succeeds. Thus, the optimal wage schemes exhibits RPE. The reason why team incentives become the optimal wage scheme is that the agent dislikes the uncertainty over his wage. Suppose that the payment solely depends on the agent's outcome. His decision depends not only on his intrinsic utility but also on his gain-loss utility. Since he attains either a high outcome or a low outcome, he feels a psychological gain by comparing it to a low wage when he gets a high wage. On the other hand, he feels a psychological loss by comparing it to a high wage when he gets a low wage. Since the feeling of loss looms larger than that of gain because of loss aversion, he has a negative expected gain-loss utility. Also, as a wage increases the disutility from loss aversion also increases proportionally. In this sense, the agent with loss aversion has a first-order risk aversion (Kőszegi and Rabin 2007). As Daido and Itoh (2010) and Herweg, Müller and Weinschenk (forthcoming) point out in single agent cases, if the degree of loss aversion is large and the probability of high outcome is small, then an mplementation problem arises under IPE

[1] See, for examples, Jones and Kato (1995), Ichniowski, Shaw and Prennushi (1997), Boning, Ichniowski and Shaw (2007).

[2] We adopt the convention of using male pronouns to refer to the agent and female pronouns to refer to the principal.

[3] Shalev (2000) investigates game theoretic models when players are loss averse.

[4] We mainly use a choice-acclimating personal equilibrium (CPE), which is defined by Kőszegi and Rabin (2007), as a solution concept. Intuitively, CPE captures the concept that the agent's action itself affects his reference point.

because the agent cares the difference of gain-loss utilities more than that of intrinsic utilities.

However, the principal can alleviate the agent's loss aversion by using team incentives. This is because the agents can get a positive wage with higher probability under JPE or RPE than under IPE. In other words, if the principal introduces team incentives, the agents can share their wage risks. By the tradeoff between the risk sharing effect and the standard incentive effect, JPE is optimal if the probability of success is small while RPE is optimal if the probability is large.

Recently, much literature investigates that the expectation-based reference-dependence is a key to understanding human decision makings and economic phenomena. Heidhues and Kőszegi (2008) analyze firms' price competition with loss-averse consumers, and argue that the firms offer a sticky (deterministic) price in an equilibrium even if their cost functions are stochastic and asymmetric. Lange and Ratan (2010) investigate a bidding behavior in auctions with loss-averse agents. Moreover, much experimental and field research has recently confirmed the importance of the expectation-based reference-dependent preferences. Crawford and Meng (forthcoming) offers and estimates a model of cab drivers' labor supply decision which incorporates loss aversion on an income and a working hour. Abeler et al. (2010) design a real-effort experiment to test a model of expectation-based reference-dependent preferences. They report the result that is consistent with the prediction by the theoretical model of expectation-based reference-dependent preferences; the higher the subjects' expectations are, the longer they work and the more they earn. As most closely related literature to our study, Herweg, Müller and Weinschenk (forthcoming) analyze a principal-agent model with moral hazard when the agent is loss averse, and shows that the principal chooses a simple bonus scheme even if he can offer a finer contract. However, they focus only on a single agent case, and much is unknown how loss aversion affects a general contract environment.

This paper contributes to a further extension of behavioral economic theory as well as contract theory. Furthermore, our result bridges the gap between current multi-agent theoretical literature and an empirical observation in a workplace, and provides a new insight that team incentives serve as a risk-sharing device among agents.

REFERENCES

Abeler, Johannes; Falk, Armin, Goette, Lorenz, and Huffman, David (2009): "Reference Points and Effort Provision," *American Economic Review*, forthcoming.

Boning, Brent; Ichniowski, Casey and Shaw, Kathryn (2007): "Opportunity Counts: Teams and the Effectiveness of Production Incentives," *Journal of Labor Economics*, 25(4), 613–650.

Che, Yeon–Koo and Seung–Weon Yoo (2001): "Optimal Incentives for Teams," *American Economic Review*, 91, 525–540.

Chiappori, Pierre André and Bernard Salanié (2003): "Testing Contract Theory: A Survey of Some Recent Work," in M. Dewatripont, L. Hansen, and S. Turnovsky ed., *Advances in Economics and Econometrics*. Cambridge: Cambridge University Press, pp.115–149.

Crawford, Vincent P. and Juanjuan Meng (forthcoming): "New York City Cabdrivers' Labor Supply Revisited: Reference-Dependent Preferences with Rational-Expectations Targets for Hours and Income," *American Economic Review*, forthcoming.

Daido, Kohei and Hideshi, Itoh (2010): "The Pygmalion and Galatea Effects: An Agency Model with Reference-Dependent Preferences and Applications to Self-Fulfilling Prophecy, " mimeo.

Green, Jerry R. and Nancy L. Stokey, (1983): "A Comparison of Tournaments and Contracts, " *Journal of Political Economy*, 91(3), 349-364.

Heidhues, Paul and Botond Kőszegi (2008): "Competition and Price Variation When Consumers Are Loss Averse," *American Economic Review*, 98(4), 1245–1268.

Herweg, Fabian, Daniel Müller and Philipp Weinschenk (forthcoming): "Binary Payment Schemes: Moral Hazard and Loss Aversion," *American Economic Review*, forthcoming.

Kahneman, Daniel and Amos Tversky (1979): "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, 47(2), 263–292.

Holmstrom, Bengt (1982): "Moral Hazard in Teams," *Bell Journal of Economics*, 13(2), 324–340.

Holmstrom, Bengt and Milgrom, Paul (1990): "Regulating Trade among Agents," *Journal of Institutional and Theoretical Economics*, 146(1), 85–105.

Ichniowski, Casey; Shaw, Kathryn and Prennushi, Giovanna (1997): "The effects of human resource management practices on productivity: A study of steel finishing lines," *American Economic Review*, 87(3), 291–313.

Itoh, Hideshi (1993): "Coalitions, Incentives, and Risk Sharing," *Journal of Economic Theory*, 60(2), 410–427.

Jones, Derek C. and Takao Kato (1995): "The Productivity Effects of Employee Stock-Ownership Plans and Bonuses: Evidence from Japanese Panel Data," *American Economic Review*, 85(3), 391–414.

Kőszegi, Botond and Matthew Rabin (2006): "A Model of Reference-Dependent Preferences," *Quarterly Journal of Economics*, 121(4), 1133–1165.

Kőszegi, Botond and Matthew Rabin (2007): "Reference-Dependent Risk Attitudes," *American Economic Review*, 97(4), 1047–1073.

Kőszegi, Botond and Matthew Rabin (2009): "Reference-Dependent Consumption Plans," *American Economic Review*, 99(3), 909–936.

Kvaløy, Ola and Trond E. Olsen (2006): "Team Incentives in Relational Employment Contracts," *Journal of Labor Economics*, 24(1), 139–169.

Lange, Andreas and Anmol Ratan (2010): "Multi-Dimensional Reference-Dependent Preferences in Sealed-Bid Auctions - How (most) Laboratory Experiments Differ from the Field," *Games and Economic Behavior*, 68, 634–645.

Lazear, Edward P (1989): "Pay Equality and Industrial Politics," *Journal of Political Economy*, 97(3), 561–580.

Lazear, Edward P. and Rosen, Sherwin (1981): "Rank-Order Tournaments as Optimum Labor Contracts," *Journal of Political Economy*, 89(5), 841–64.

Shalev, Jonathan (2000): "Loss Aversion Equilibrium," *International Journal of Game Theory*, 29, 269–287.