One of the fundamental questions in agency theory is why linear or commission based contracts are so common in practice, particularly in sales force compensation, while classical agency models often prescribe more complicated contract forms (Conlon 2009)? This is an outstanding problem in sales force incentives and agency theory. As Holmström and Milgrom (1987) state in their classic paper on linear contracts in dynamic environments:

*It is probably the great robustness of linear rules based on aggregates that accounts for their popularity. That point is not made as effectively as we would like by our model; we suspect that it cannot be made effectively in any traditional Bayesian model. But issues of robustness lie at the heart of explaining any incentive scheme which is expected to work well in practical environments.*

This paper aims to address sales force compensation or agency theory with model uncertainty or parameter uncertainty. In practice, decision makers, e.g., firms, usually have ambiguity or distrusts among their statistical models (Hansen and Sargent 2008). For example, when firms use statistics to predict the output distributions relying on past sales data, they usually obtain confidence intervals for the parameter estimates. When the historical sales data is not available, e.g., data for new products or agents, or insufficient, e.g., data with low quality or censored by inventory stocks, this issue can be even more serious. Model uncertainty or parameter uncertainty is ubiquitous in practice as firms do not precisely know how the output is affected by sales agent efforts. Suppose
that a firm would like to design a contract that is robust to model uncertainty. What should be the form of such a contract? Would a simple linear contract be optimal?

In our model, as in standard moral hazard models, the sales agent takes an unobservable costly effort, which affects the random output. The firm provides incentives by paying the sales agent based on the observed output. The objective of the risk-neutral firm is to maximize the expected value of output minus the wage paid out. The sales agent has limited liability. But unlike in most of the literature, the firm in our model does not know exactly the parameters of the output probability distribution, but knows that the parameters can be in a range, e.g., an ellipsoidal uncertainty set. In the presence of the parameter uncertainty, we propose the notion of robust contract design: (1) any contract is judged by its worst-case performance, given the firm’s knowledge; (2) the incentive compatibility condition should hold for any possible parameters in the uncertainty set, equivalently the sales agent also adopts the worst-case criterion; (3) the firm would like to identify the contract that maximizes his worst-case performance.

When the sales agent is financially risk neutral, to avoid his exerting the lowest effort, we find that the optimal robust contract is a linear contract—paying the sales agent a base payment and a fixed share or commission rate of the realized output. In fact, no other contract forms, including nonlinear contracts, are robust to the parameter uncertainty. In this sense, our paper partially answers the call from Holmström and Milgrom as our contract is non-Bayesian and provides a new explanation for the popularity of commission based contracts in practice, i.e., indeed the linear contracts are the only type of contracts that are robust to the parameter uncertainty. In other words, nonlinear contracts may fail to incentivize agents to exert effort if there is ambiguity over the model for output.

Moreover, when the sales agent is financially risk averse, a piecewise linear contract is approximately optimal and robust to the parameter uncertainty. Furthermore, the optimal contract can have progressive or regressive commission rates depending on the risk aversion characteristics of the sales agent. As argued by Basu et al. (1985), the optimal contracts can be best approximated by the piecewise linear contracts and most commonly used contracts in practice are special cases
of the piecewise linear contracts. In this sense, the robustness of the piecewise linear contract may accounts for its prevalence in practice.

Our results are robust to a wide variety of settings, including cases with general output distribution, Lp-norm uncertainty set, multiple effort levels, and a risk averse sales agent with mean-variance utility. Moreover, replacing the limited liability condition with participation constraints does not affect the optimality of linear contracts but only the base payment for the sales agent. As a matter of fact, the consistent information set and the worst-case criterion plays the critical role in the optimality of linear contracts.

References


