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Price delegation and salesforce contract design with asymmetric risk aversion coefficient of sales agents

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ABSTRACT

An important issue that has attracted the interest of academics and practitioners in both marketing and operations is, should pricing decisions be made by the firm or delegated to the salesforce? This problem has been addressed in the research literature based on the assumption that the exact risk aversion coefficients of the sales agents are known to the firm, which may not be true in most applications. In this paper, we study this problem but assuming that the risk aversion coefficients of agents are private information of the sales agents. For both centralized pricing and delegated pricing settings, the optimal compensation and pricing contracts are designed and the sensitivity analyses are conducted. An interesting finding is that the risk aversion and effort valuation have substitutable impacts on the pricing policy preference of the firm and the agents. Either strong risk aversion or high effort valuation can drive the firm and the agents to favor centralized pricing over delegated pricing.

1. Introduction

An important question that has attracted the interest of academics and practitioners in both marketing and operations is, should pricing decisions be made by the firm or delegated to the salesforce? There appears to be no unconditional answer to this question from practical and theoretical perspectives, because examples of both pricing policies can be found in marketing practice and there are theoretical works favoring both pricing policies, e.g., Lal (1986), Weinberg (1975), and Mishra and Prasad (2004), among others. The problem is complicated by the risk preference of the firm and the agents, the type of information asymmetry, and the sequence of events. In these studies, the risk aversion coefficient of sales agent is modeled as a parameter in the utility function and it is assumed to be common information. In real world applications, however, it is very difficult for one to observe the exact risk preference of another player (Tsay, 2002; Xiao and Yang, 2009). This motivates us to consider the case that a salesperson's risk aversion coefficient is private information to the salesperson that can only be partially observed by the firm, and we examine the impact of salesperson's asymmetric risk aversion on the firm's pricing decision. We formulate a model composed of multiple risk-averse agents with private risk aversion coefficients and examine both pricing delegation and risk aversion issues under the framework of salesforce contract design. Specifically, we are interested in addressing the following questions: (1) How does the asymmetric information on salesperson's risk aversion coefficient affect the firm's pricing decision? (2) How do prices and contracts vary under centralized pricing and delegated pricing, respectively? (3) Which pricing policy is preferred by the firm? And which one is beneficial to the agents?

To study these issues, we build a principal-agent model with one risk-neutral firm and multiple risk-averse agents, where the agents have private risk-averse coefficients and make sales effort unobservable to the firm to maximize their expected utilities. The firm offers a menu of compensation contracts to allow each agent to self-select the actual contract. We analyze both centralized pricing, i.e., the price is determined by the firm, and delegated pricing, i.e., the pricing authority is delegated to each individual agent. This paper aims to examine how the asymmetric information on salesperson's risk aversion coefficient affects the firm's pricing decision under both centralized pricing and delegated pricing. For both pricing policies, a closed-form linear contract is designed which simultaneously induces every risk-averse agent to select a unique contract from it that maximizes the firm's expected profit. For both single-agent and multi-agent cases, we derive the sufficient condition for centralized pricing to outperform price delegation from the perspectives of both the firm and the agents. It shows that when the agents are highly risk-averse and have high effort valuation, both the firm and the agents favor centralized pricing over price delegation.

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Delegating pricing responsibility to the salesforce has attracted the interest of many researchers in marketing (Bhardwaj, 2001; Stephenson et al., 1979, Lal, 1986; Weinberg, 1975). There are papers favoring price delegation (e.g., Lal, 1986; Weinberg, 1975). Lal (1986) shows under certain situations with demand information asymmetry, it is more profitable for the firm to delegate pricing authority to the salesforce than to centrally control it, since the agents have more regional knowledge. In contrast, Mishra and Prasad (2004) find that when the salesperson's private information can be revealed to the firm through contracting, centralized pricing performs at least as well as price delegation. Further, they show that for a broad class of situations it is no worse for the firm to set prices than to delegate the pricing responsibility to the salesforce. Our paper is different from Mishra and Prasad (2004) which assume that the salesperson has a quasi-linear utility function and the firm is free to design an optimal compensation plan. In contrast, we focus on the linear compensation contract with the presence of information asymmetry. Meanwhile, we pursue the investigation further by comparing the pricing policies from the perspectives of both the firm and the agents. Most importantly, the asymmetric information in our study is the risk aversion coefficient of the salesperson. We believe that the risk aversion coefficient of any salesperson is a private information that is only known to the salesperson himself, other parties only have a partial observation and/or estimation of a salesperson's risk aversion coefficient. We show that the agents' risk aversion coefficient and effort valuation have substitutable impacts on the pricing policy preference of the agents and the firm.

Besides the monopoly markets analyzed by above papers, price delegation in competitive settings has also been studied. Bhardwaj (2001) considers the competition of price and sales agents' effort with symmetric demand information and show that, for several linear and nonlinear contracts, there exist parameter values where centralized pricing by each firm is the unique equilibrium, and other parameter values where price delegation by each firm is the unique equilibrium. Mishra and Prasad (2005) also examine the price delegation issue with two competitive firms using standard agent theory but with both symmetric and asymmetric demand information. Under symmetric information they find that the optimal contract allows managers to reach the upper bound on firm's profit by using either centralized or delegated pricing. Under asymmetric information they find that there always exists an equilibrium where all firms use centralized pricing. Different from these papers, we consider one firm and multiple agents and study the contract design for risk-averse salesforce with private risk aversion coefficients. Bhardwaj (2001) and Mishra and Prasad (2005) focus on the decision of competing firms, while we obtain closed-form solutions to compare the utilities of both the firm and the agents under both centralized pricing and delegated pricing. We find that both the firm and the agents prefer centralized pricing to delegated pricing when the agents are very risk-averse and value their efforts highly.

The analytical underpinnings for our work are provided by the principal-agent paradigm, and the model in this paper is a combination of moral hazard and adverse selection. Another closely related literature stream is salesforce incentive, which has been widely studied in the marketing literature (Coughlan, 1993). Many works study the compensation incentives to induce salespeople to disclose their private information about the market (Gonik, 1978; Mantrala and Raman, 1990). Recently, Chen (2005) compares Gonik's solution with a menu of linear contracts. And Chen (2000) proposes a compensation package to induce the salespeople to exert effort in a way that actually smooths the demand process. Similar to this paper, Jullien et al. (2007) analyze a model composed of one principal and multiple risk-averse agents, where the agents' risk aversion can be public or private information. In Jullien et al. (2007), the risks faced by the agents are binomial income risk: success or failure, and the principal motivates the agents simply by offering a higher payment for success. In contrast, in our setting, the firm makes pricing decisions and offers the base salary and the commission rate to motivate the sales agents. We contribute to this growing body of research literature by examining the pricing decision in the informational and contracting framework of agent theory.

Finally, since our model relates to risk-aversion, we review this stream of literature. There is a considerable literature studying inventory decisions of a single risk-averse agent, e.g., Eeckhoudt et al. (1995), Chen and Federgruen (2000), and Gaur and Seshadri (2005). There have also been a few studies of supply chains consisting of one or more risk-averse agents, e.g., Lau and Lau (1999), Agrawal and Seshadri (2000a), Tsay (2002), and Yoo (2014). A number of papers are devoted to the study of coordination in supply chains involving risk-averse agents (Gan et al., 2004; Van Mieghem, 2003). Gan et al. (2004) generalize the coordination solution in the risk-neutral case by defining it as one that results in a Pareto-optimal solution acceptable to each agent and develop coordination contracts for many scenarios with risk-averse players. In a recent work, Xu et al. (2014) consider a manufacturer that produces a single product and distributes it through her wholly owned direct channel and through an independent retail channel, which also sells the product to the customers. They propose a two-way revenue sharing contract to coordinate the dual-channel supply chain with risk aversion formulated under a mean-variance model. As a summary, Choi et al. (2011) present a table categorizing the literature on risk-averse inventory models. Our paper is different from the papers mentioned above in that the analytical underpinnings for our work are in the principal-agent paradigm rather than supply chains and our goal is to examine both pricing delegation and risk aversion issues under the framework of salesforce contract design. Our paper contributes to this line of research by considering a contract design problem when the agents' risk-averse coefficients are asymmetric information.

A number of papers are devoted to analyze the impact of risk aversion on other decisions besides inventory. For example, taking into account the strategic claim behavior and risk attitudes, Gallego et al. (2015) apply ideas from stochastic optimal control theory to design and price residual value warranties to maximize expected profits. Borgonovo and Peccati (2009) discuss the effect of risk measure selection in the determination of inventory policies. Avinadav et al. (2015) focus on analyzing how risk-sensitive behavior of supply chain members affects chain performance. The equilibrium strategies are derived when the members have different risk preference: averse, neutral and seeking. Xiao and Yang (2008) consider uncertainty and risk sensitivity under the price and service competition structure of two independent chains, each consisting of one risk-neutral supplier and one risk-averse retailer. They find that the higher the risk sensitivity of one retailer, the lower her optimal service level and retail price, while the impacts of the rival's risk sensitivity on her decisions depend on the substitutability between the two products. In a later work, Xiao and Yang (2009) analyze a supply chain consisting of a one risk-neutral manufacturer and one risk-averse retailer facing an outside integrated competitor, where the risk sensitivity of the retailer is private information. They investigate how the manufacturer designs a wholesale price-order quantity contract to induce the retailer to report his risk sensitivity information truthfully and study the effect of the risk-sharing rule on the revelation mechanism under demand uncertainty. They find that the strategic interaction significantly impacts in the effect of risk sensitivity on the order quantity and when the fraction of the risk cost shared by the manufacturer is sufficiently large (small), the optimal wholesale price for the high risk-averse retailer is higher (lower)