



# An experimental study on the effects of minimum profit share on supply chains with markdown contract: Risk and profit analysis



Pui-Sze Chow<sup>a</sup>, Yulan Wang<sup>b</sup>, Tsan-Ming Choi<sup>a</sup>, Bin Shen<sup>c,\*</sup>

<sup>a</sup> Business Division, Institute of Textiles and Clothing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

<sup>b</sup> Department of Logistics and Maritime Studies, Faculty of Business, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

<sup>c</sup> Glorious Sun School of Business & Management, Donghua University, Yan An Road (West) 1882, Shanghai 200051, China

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## ABSTRACT

Supply chain performance measures include both profit and risk. In this study, we examine the effect of retailers' minimum profit share concerns on supply chain system performance through laboratory experimental and analytical modeling approaches. In the experiment, each retailer's minimum profit share, which partially reflects her self-serving fairness concern, is measured with a parameter defined as the *minimum profit share ratio* (MPSR), which is the ratio of the retailer's profit to the whole supply chain profit. We specifically consider a two-stage supply chain in which a supplier offers a take-it-or-leave-it markdown contract to a retailer who has an MPSR concern. In our laboratory experiment, the role of the supplier is played by human subjects who are practitioners in the fashion industry; to ensure that the MPSR concept is fully implemented, the role of the retailer is played by the computer. Mirroring the observed industrial practice, the markdown price is defined as a fixed percentage of the wholesale price, and the supplier needs to decide on a wholesale price. Our empirical results show that when the MPSR increases, the supplier's average profit and absolute risk decreases, whereas those of the retailer increase. As for the whole supply chain, our experiments suggest there is an inverse U-shaped relationship between the supply chain profit and the MPSR; thus the presence of an MPSR concern leads to a higher supply chain risk (both in absolute and relative terms). We also observe that when the retailer tends to split the supply chain profit equally with the supplier (MPSR=0.5; in this case, neither party faces disadvantageous inequality), the whole supply chain achieves the best performance, and the supply chain profit is close to the theoretically optimal one (the centralized supply chain profit). In other words, a fair retailer helps to create a sense of cooperation between the supplier and herself.

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## 1. Introduction

Self-interested behavior is a part of all active relationships [35]. A self-serving bias occurs in a relationship when individuals subconsciously alter their fundamental views about what is fair or right in a way that benefits their interest [14]. As one of self-serving biases, self-serving fairness affects an individual's preferences and favors his own payoff [22]. In a supply chain setting, it is widely observed that individual supply chain agents have concerns on their own profit as well as their share of the total supply chain profit [12]. This issue relates to fairness concern as well as the sustainability of their own business [24]. As such, in this study, we examine the impacts brought by the minimum profit share ratio (MPSR), which is defined as the retailer's profit over the whole supply chain profit, on the supply chain in the presence of a

markdown contract. Undoubtedly, the MPSR relates to the retailer's fairness concern and we argue that it partially reflects her<sup>1</sup> "self-serving fairness".<sup>2</sup> For example, if a retailer's MPSR is 0.5, it means that she seeks to gain 50% of the supply chain profit as her payoff.

Enterprises are primarily driven by the desire to earn at least their fair share. In a profit-maximization environment, the enterprises within a supply chain often possess their own MPSR; that is, each party seeks to capture a certain percentage of the whole supply chain profit. If the profits are below this percentage, the party may not have incentives to join the supply chain. Previous studies suggest that supply chain contracts such as markdown [48], revenue sharing, and sales rebates can align supply chain parties' interests and coordinate the supply chain [6,30]. However, these studies do not consider the

\* Corresponding author.

E-mail address: [binshenjerry@gmail.com](mailto:binshenjerry@gmail.com) (B. Shen).

<sup>1</sup> In this paper, we use "she" and "he" to represent the retailer, and the supplier, respectively.

<sup>2</sup> We do admit that the MPSR is not equivalent to the fairness concern.

decision maker's concerns about MPSR. In this study, we consider a two-stage supply chain in which the retailer (she) is self-serving and holds an MPSR. The contract between the supplier (he) and the retailer is a markdown contract, which is widely adopted in many industries, including the fashion industry. For example, fashion brands such as Lady Forever and Desinice in China, and Tommy Hilfiger and Liz Claiborne in the U.S.A. all adopt a markdown contract when dealing with their retail partners [52,16,41]. Markdown contract helps the aforementioned firms improve their business performance. According to the executive manager of Lady Forever, after implementing the markdown contract in its 115 trial stores in 2010, the company's net profit increased by 45 percent over 2009 [52].

Enterprises also have concerns on risk. This gives rise to the emerging field known as enterprise risk management (ERM) which refers to an integrated approach to managing risk faced by an enterprise with a goal of seeking the most effective way to deal with risk [50]. In fact, in the context of supply chain management, ERM also presents in two levels: The individual enterprise (i.e., supply chain agent) level and the whole supply chain-level. Undoubtedly, nowadays, profit and risk are both crucial measures for supply chain performance [2,37,21]. Motivated by the importance of profit and risk considerations and the retailer's concern on the MPSR, we conduct a behavioral study in this paper.

In this study, we use a laboratory experiment to investigate how retailers' concerns about MPSR affect the performance of the markdown contract and the supply chain. We consider a classic newsvendor [40] setting in which the supplier, as a Stackelberg leader, offers the markdown contract, and the retailer decides whether to take it or leave it according to her MPSR concern. Naturally, the retailer is more likely to accept a contract if her MPSR is low. In our experiment, the role of the supplier is played by human subjects who are practitioners in the fashion industry. We use a controlled laboratory setting that is designed to conform to the assumptions of the contract model we are testing. To ensure that the MPSR concept is fully implemented by the retailer, the role of the retailer is played by a computer. *To the best of our knowledge, this study is the first one to use laboratory experiments to study the effect of MPSR on supply chain performance.*

Our experiments yield several interesting findings. First, we find that a retailer is more likely to reject a contract when she holds a higher MPSR, and this leads to the failure of supply chain coordination. Second, a higher MPSR induces a lower average wholesale price. Third, there is an inverse U-shaped relationship between supply-chain profit and the retailer's MPSR; that is, the average profit of the supply chain first increases and then decreases as the retailer's MPSR increases. Moreover, the presence of an MPSR concern leads to higher supply chain risk (measured with respect to profit uncertainty), both in absolute (standard deviation) and relative (coefficient variation) terms. We observe that when the retailer has no MPSR concern, that is, when the MPSR equals zero, the supplier tends to split the supply chain profit equally with the retailer, whereas when the retailer's MPSR equals 0.5, that is, when the retailer wants to split the supply chain profit equally with the supplier, the whole supply chain achieves the best performance with the supply chain profit most closely to the theoretically optimal one.

This paper is organized as follows. In Section 2, we review the related theoretical and behavioral literature. Section 3 describes our analytical background and Section 4 details our laboratory settings. The experimental results are given in Section 5 and discussed in Section 6. Section 7 concludes the paper with general remarks and managerial implications. All of the technical proofs are relegated to the Appendices.

## 2. Literature review

Three streams of research relevant to this study are briefly reviewed below.

### 2.1. Reservation profit level

The MPSR concern is related to the concept of reservation profit level (RPL), which has been widely explored in the supply chain management literature. In Cachon [6], RPL is treated as a means to model a firm's bargaining power. A party accepts a contract only if the contract achieves at least his/her RPL and a higher RPL implies that the party holds a higher bargaining power. Corbett et al. [12] consider a vertical contracting environment with one supplier and one retailer. They assume that each player has an exogenously given RPL, below which they refuse to trade. In contrast to Cachon [6] and Corbett and Fransoo [12], Bernstein and Marx [3] consider a scenario in which the RPL endogenously depends on the retailer's opportunities within the supply chain; they investigate the effect of the retailer's RPL on the allocation of total supply chain profit among all of the channel members. Cachon and Kok [7] consider a supply chain in which two manufacturers distribute substitutable products through a common retailer. They compare three supply chain contracts and show that the retailer's RPL depends on the contract type offered by the manufacturer; thus, competition between manufacturers enables the retailer to capture more of the supply chain profit. In the aforementioned studies, RPL is defined as an absolute number that is either endogenously determined or exogenously given. In our study, MPSR is defined as a constant ratio. A higher MPSR implies a higher bargaining power. Exploiting bargaining power is one way of showing people's fairness [4].

### 2.2. Fairness in the supply chain context

Recently, the issue of fairness has become a hot topic in the supply chain management field. Cui et al. [13] are the first to model fairness concerns in the context of supply chain coordination. They assume that fairness concerns are public information and they identify two types of retailers' inequality aversion, which have different effects on supply chain coordination: aversion to disadvantageous inequality and aversion to advantageous inequality. Under the effect of aversion to disadvantageous inequality, a retailer is only concerned with avoiding making less profit than the supplier. The authors theoretically prove that aversion to disadvantageous inequality worsens supply chain inefficiency, as it will cause the retailer to *punish* the supplier by setting an excessively high market price. Unlike Cui et al. [13], we consider that fairness concerns are private knowledge, and thus in our model the retailer is only concerned with avoiding making less profit than what her MPSR concern suggests. In addition, in our experiments the retailer will punish the supplier by rejecting the contract if the provided contract does not satisfy her MPSR concern. Katok et al. [23] investigate fairness concern in the context of a wholesale price contract. They find that the contract can coordinate the channel when the fairness concern is sufficiently significant, but that the supply chain is less efficient if fairness concerns are not strong. Ho et al. [20] experimentally investigate how distributional and peer-induced fairness concerns interact and how this affects supply chain performance. Their experimental data suggest that a peer-induced fairness concern is more salient than a distributional one. Most recently, Katok and Pavlov [24] indicate that when the supplier has incomplete information about the retailer's preferences for fairness, a theoretically coordinating contract may not coordinate the supply chain.

The concept of fairness emerges from equity theory [38], which was first developed by Adams [1] in his study of employer–employee relationships in the workplace. Recently, equity theory has been applied to study fairness in supply chain management [38]. According to Scheer et al. [42], equity theory states that a party evaluates an ongoing relationship by assessing his or her

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