

Retail And Financial Department Structure Design for Retailers: A Supply Chain Finance Perspective

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Abstract. In order to study the organizational structure design of the retailer's financial and retail sectors under the conditions of manufacturer's financial constraints and output uncertainty, this article is based on a two-party dynamic that includes manufacturers with uncertain output and large retailers that can provide financial support. Through the game model, the optimal contract design of the retailer under different organizational structures was obtained by solving the corresponding equilibrium results, and the optimal organizational structure design of the retailer was obtained by analyzing the corresponding equilibrium results. Departmental capital costs are decreasing monotonically. The result of analyzing the manufacturer's output uncertainty shows that the most favorable complete output probability for the retailer is lower than the manufacturer's optimal complete output probability. Extending the model to consider the existence of external financial institutions, the manufacturer's financing model selection plan was obtained. This research provides theoretical support and reference for the financing and operation decisions of retailers, manufacturers, and external financial institutions in the context of supply chain finance.

Keywords: supply chain finance; yield uncertainty; divisional structure design; operating decision; financing decision.

1. Introduction

Currently, almost all major retail enterprises are attempting to expand their financial operations. Particularly, retail businesses with annual sales exceeding 10 billion are primarily focusing on establishing themselves as "industrial banks" in the fields of supply chain finance and consumer finance. For instance, companies like JD Group's JD Finance and Amazon Group's Amazon Lending Program are notable examples.

On one hand, the retail departments of these companies frequently interact with a substantial number of upstream suppliers, manufacturers, and downstream consumers, many of whom have financing needs. Simultaneously, the expansion of retail operations accumulates sufficient corporate credit and behavioral data, which serve as a foundation for financial services. On the other hand, the financial departments of these companies, involved in supply chain finance, attract more partners from the retail business, such as suppliers and manufacturers. This not only generates financial gains from upstream supply chain members but also addresses the financing difficulties of small and medium-sized enterprises and rectifies supply chain imbalances.

However, many of the upstream businesses making financial demands from these major retailers are often small to medium-sized manufacturing companies. These smaller manufacturers encounter not only funding shortages but also face the risk of output uncertainty due to their internal conditions and external environments. Consequently, the first research question of this paper is: What is the optimal contract design for retailers when engaging in business and financial operations with such manufacturers facing output uncertainty?

As these retail enterprises expand their overall business and departmental operations, they will confront more complex coordination and management challenges within and between departments. Consequently, many businesses are choosing to separate their financial departments and operate them independently. For instance, companies like Alibaba Group's financial subsidiary, Ant Financial Services Group, eBay's PayPal, JD Group's JD Finance, and Suning Financial Services separated

from their parent companies in October 2014, July 2015, June 2017, and September 2019, respectively, gaining business independence.

Financial analysts have suggested that the separation of company financial departments will enable them to operate more independently in financial services while allowing their parent retail companies to focus on their core retail businesses. Classical literature on corporate organizational structures indicates that the centralized operation of company departments not only reduces conflicts between departments pursuing individual profit maximization and the overall profit maximization of the company but also enhances the bargaining power with upstream supply chain members. Nevertheless, the interdepartmental conflicts arising from decentralized operations can alleviate the double marginal effects in the supply chain, thereby increasing the company's ultimate profit. Consequently, the second research question of this paper is: What is the optimal organizational structure for the retail and financial departments of large retailers with both retail and financial businesses?

From the perspective of upstream manufacturers, on one hand, companies need to minimize the risks associated with output uncertainty to maximize profits. On the other hand, reducing output uncertainty often requires a certain amount of investment. For small and medium-sized enterprises already lacking resources, this becomes a critical decision. Hence, the third research question of this paper is: What is the optimal level of output for manufacturers facing both funding shortages and output uncertainty risks?

To address these three research questions, this paper constructs a two-player dynamic game model, including a manufacturer facing output uncertainty and a large retailer capable of providing financial support. Moreover, considering that manufacturers may also seek financing support from third-party financial institutions like banks, an extended model takes into account the financing mode selection strategy of manufacturers.

The remainder of this study is organized as follows. In section 2, we briefly summarize the related literature. In section 3, we describe our model. In section 4, we derive the optimal integrated strategy from analyzing the advantage of probabilistic selling and return policies. In section 5, we summarize the insights drawn from the analysis, offer concluding remarks, and suggest areas for future research.

2. Literature Review

The research presented in this paper falls within the interdisciplinary domain of operations management and finance. Relevant research primarily encompasses three main areas: (1) the study of corporate organizational structures, (2) research on supply chain trade credit, and (3) investigation of corporate output uncertainty. Research on corporate organizational structures primarily focuses on the balance between decentralized and centralized operations. In contrast to the literature mentioned above, this paper primarily addresses coordination issues between the retail and financial departments of large retail enterprises. Studies on supply chain trade credit, from the perspective of companies facing funding constraints, can be categorized into three types: downstream companies facing funding constraints, upstream companies facing funding constraints, and situations where both upstream and downstream entities have funding constraints. Unlike existing literature on trade credit, this paper places particular emphasis on organizational structure issues of firms providing trade credit. As supply chain risk management continues to evolve, the issue of output uncertainty has gained attention in the academic community. However, existing research on output uncertainty primarily focuses on supply chain operational decisions and gives less consideration to questions related to corporate organizational structure and trade credit. The existing literature on probabilistic selling extensively study why, when, and how probabilistic selling is used in a non-refundable setting. [1] first demonstrate that probabilistic selling can be a general marketing tool that potentially benefits sellers in many different industries. Probabilistic selling can separate heterogeneous consumers, thus encouraging customers to reveal their heterogeneity via self-selecting whether or not to purchase the uncertain product, which is used by a seller [1, 3, 4, 5] as well as an opaque intermediary [6]. Although the existing literature richly illustrate the advantage of probabilistic selling within a non-refundable

framework, whether it still profitable in a refund-available setting remains an uncharted domain. To the best of our knowledge, this study is the first to shed light on return policies in probabilistic selling. In contrast to the conventional wisdom that a no-refund policy should be strictly enforced in probabilistic selling, we find that profits are accessible from the approach of providing partial return policies or even full return policies.

The other related literature stream investigates return policies, which are oriented to two broad and interrelated domains of research: consumer behavior and planning and execution [7]. In contrast with the finding in [8], we find that a generous return policy of probabilistic products, which have no supplementary fixed costs and lead time incurred from design and physical production, may lead to a larger assortment.

3. Model

The seller offers two horizontally differentiated component products, which have symmetric production costs through the online channel. To rule out trivial cases where the demand drops to zero because of exorbitant production cost, we assume $0 \leq c < 1$. We assume that the seller is aware of the demand. The seller has three alternative integrated strategies: traditional selling with refunds ($K = TC$), probabilistic selling in which refunds are only accessible for component products ($K = PC$), and Probabilistic selling in which refunds are available for all products ($K = PA$).

Returns from customers are salvaged at the value s . A low value of s represents a situation where the reverse logistics cost for the seller to remarket the returned product is high. The returned products may need an inspection, and in some cases reconditioned before being put back to inventory.

For online consumers, physically inspecting (“touch and feel”) products before purchasing is not available, from which fit uncertainty emerges. To capture this fit uncertainty (also referred to in the returns literature as valuation uncertainty), we assume that the homogeneous ex-ante probability of a product fit is α , and the mismatch with probability $1 - \alpha$, in which the consumer receives zero utility [9]. In addition, when consumers purchase a probabilistic product, which can turn out to be any of the component products, they will also face uncertainty about the product assignment. After receiving the probabilistic product, this assignment uncertainty will be resolved [3]. Additionally, under the PA strategy, consumers can decide whether to keep the probabilistic product based on their heterogeneous ex-post valuation net of the purchase price and the “return hassle cost” h .

We assume that consumers are distributed uniformly over $[0, 1]$ as in the Hotelling model, and we scale the market size to 1. For a consumer located at x on the Hotelling line, the valuation from purchasing product is given by $v_j(x)$ where:

$$v_j = \begin{cases} 1 - tx, & J = 1 \\ 1 - t(1 - x), & J = 2 \\ 1 - \frac{t}{2}, & J = o \end{cases} \quad (1)$$

Each rational consumer is assumed to purchase no more than one unit of one product, i.e., there is no value from consuming a second product. Each consumer makes three decisions sequentially. Initially, they decide whether to purchase a product and which product to purchase based on their ex-ante expected surplus ES_j^K , which is given by:

$$ES_j^K = \begin{cases} \alpha(1 - tx) + (1 - \alpha)(p - h) - p, & J = 1 \\ \alpha(1 - t + tx) + (1 - \alpha)(p - h) - p, & J = 2 \\ \alpha\left(1 - \frac{t}{2}\right) - p, & J = o, K = PC \\ \alpha\left(1 - \frac{t}{2}\right) + (1 - \alpha)(p - h) - p, & J = o, K = PA \end{cases} \quad (2)$$

After receiving the purchased product, both fit uncertainty and assignment uncertainty will be resolved. Customers then decide whether to keep or return it for a refund based on their ex-post surplus $S_j^K(x)$, which is given by:

$$S_j^K = \begin{cases} v - p, & \text{fit and keep} \\ -h, & \text{fit but return} \\ -p, & \text{unfit} \end{cases} \quad (3)$$

Sequence of events. (1) The seller decides the integrated strategy K . (2) The seller determines the product price p_j^K . (3) Consumers make their purchase decisions. (4) Customers make their return decision. We solve the game backward to ensure subgame perfection.

4. Analysis—Optimal Integrated Strategy

We derive the seller's optimal integrated strategy from the three alternative strategies-- TC , PC , and PA . Proposition 1 shows when each of the three integrated strategies could be optimal.

PROPOSITION 1 (OPTIMAL INTEGRATED STRATEGY). Probabilistic selling which creates the assignment uncertainty and return policies which clear away both fit uncertainty and assignment uncertainty can help the seller depending on (a) the fit probability between component products and the consumer's taste and (b) the horizontal differentiation of component products. The conditions under which one strategy dominates the others are given in the table below.

Table 1. Optimal Integrated Strategy

	Conditions required		
Optimal strategy	Fit probability	Horizontal differentiation	Implication
Traditional selling with refunds	Low	Does not matter	$\Rightarrow$ Strong fit uncertainty
Probabilistic selling in which refunds are accessible only for component products	High	High	$\Rightarrow \begin{cases} \text{Weak fit uncertainty} \\ \text{Strong assignment uncertainty} \end{cases}$
Probabilistic selling in which refunds are available for all products	Mid-range	High	$\Rightarrow \begin{cases} \text{Moderate fit uncertainty} \\ \text{Polarized assignment uncertainty} \end{cases}$
	Mid-range	Low	
Formally, TC is optimal if $t < \bar{t}^{PA_N}$ and $\alpha < \alpha_3$ or $\bar{t}^{PA_N} < t < \underline{t}^{PA_p}$ and $\alpha < \alpha_4$ or $t > \underline{t}^{PA_p}$ and $\alpha < \alpha_5$; PC is optimal if $\bar{t}^{PA_N} < t < \underline{t}^{PA_p}$ and $\alpha > \alpha_4$ or $t > \underline{t}^{PA_p}$ and $\alpha > \alpha_2$; otherwise, PA is optimal.			

Proposition 1 illustrates that the optimal strategy mainly depends on two variables: (a) the fit probability between the component products and the consumer's taste α and (b) the horizontal differentiation of the component products t . We present a visual illustration of Proposition 1 in Figure 1.

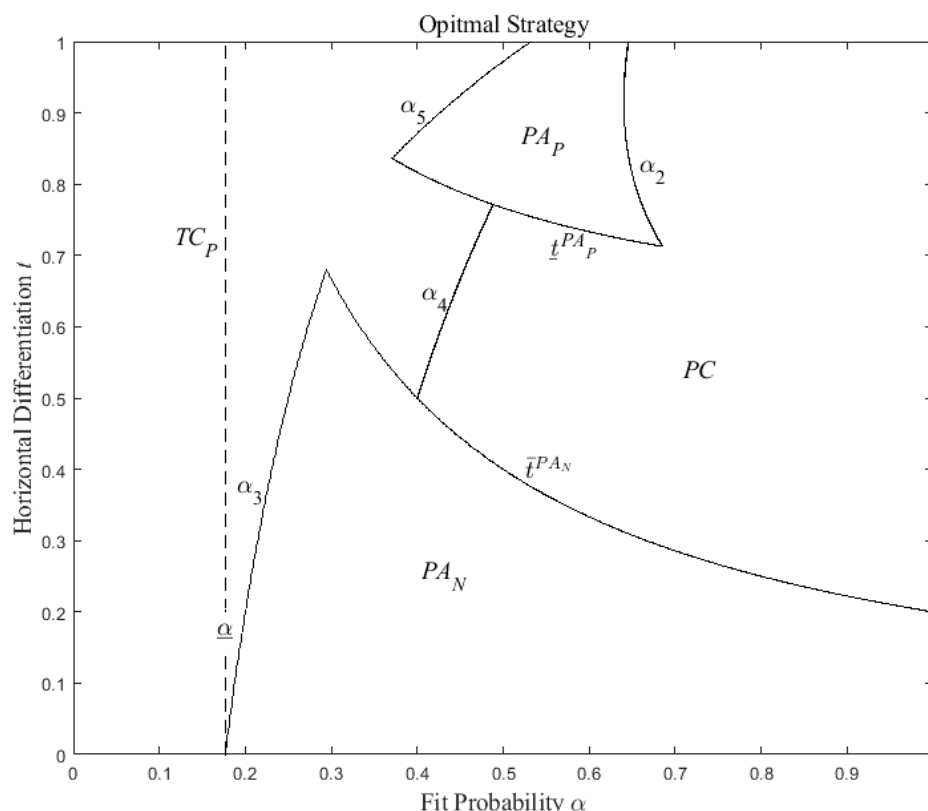


Figure 1. Optimal Strategy

Notes. The following parameter values are used: $c = 0.3$, $s = 0.2$, and $h = 0.05$. The notations TC_P , PA_P and PA_N represent partial market target under TC strategy, partial return target under PA strategy, and no return target under PA strategy, respectively. Qualitatively, the results do not change for other values of the parameters.

5. Conclusion

In recent times, nearly all retail businesses have been actively exploring opportunities in the financial services sector. This strategic move aims to enhance profitability and establish a stronger presence in the retail market, particularly by offering supply chain finance services to attract more retail partners. However, many cash-strapped upstream enterprises grapple with output uncertainty. Moreover, empirical evidence suggests that financial divisions, as their parent companies expand, tend to become independent entities. Given the limited attention in existing research to these specific challenges, this paper delves into the optimal coordination mechanisms between the retail and finance arms of downstream retailers when upstream manufacturers face capital constraints and output uncertainty. After constructing and analyzing a dynamic game model that includes manufacturers facing output uncertainty on one end and large retailers providing financial support on the other, the following conclusions are drawn:

Firstly, retailers with different structures exhibit distinct approaches to retail and finance operations. Retailers with a centralized structure possess stronger bargaining power, making it unnecessary to tailor contacts based on varying levels of output. Retailers primarily focused on retailing benefit from targeted contact design while maintaining access to unified retailing contact. Those with a strong orientation toward financing are most vulnerable to risks and must adjust their contacts in line with manufacturers' output.

Secondly, the key factor influencing a retailer's organizational structure is the cost advantage of its finance arm. A centralized structure with enhanced bargaining power is preferable when the advantages of decentralized operation and dominance are both below specific threshold values. Organizational structures driven by retail business are favored when the benefits of decentralized

operation exceed a certain value and those from dominance fall below a threshold value. The retail-dominated structure is overshadowed by the finance-dominated framework when both the advantages of decentralized operation and dominance surpass specific values, during which the finance arm requires fewer capital costs.

Thirdly, the threshold value associated with a centralized structure decreases monotonically as the cost of funds provided by the finance sector increases. In other words, the lower the cost, the narrower the threshold range. High costs of funds during centralized operation drive retailers to separate the finance arm, enabling them to focus on their core business and gain a competitive advantage by reducing costs.

Fourthly, for manufacturers with varying output levels and retailers with different organizational structures, there exists an optimal whole output probability for each side. Interestingly, the retailer prefers the manufacturer to not have an excessively high whole output probability. This is because when the whole output probability exceeds a specific value, the subsequent high wholesale price and advantageous lending rates become less significant compared to the losses incurred by the reduced input from the manufacturer, ultimately diminishing retail-side profits.

Fifthly, the financing mode is largely determined by the relative advantage of the finance sector over the bank's cost of capital and the enterprise's dominance advantage when a third-party financing source is available to the manufacturer. Specifically, capital from a bank is preferred when the advantages of decentralized operation and dominance are below specific threshold values. Retailer-oriented financing is favored when the advantages of decentralized operation surpass a certain value and those from dominance remain below a threshold value. When both of these values exceed specific thresholds, the manufacturer turns to capital funded by the retailer oriented toward finance.

Management application: in light of our findings, we offer the following insights for management. Retailers engaged in both retailing and finance must align their organizational structure with the cost of funds generated by the finance arm. If the leverage gained from centralized operation does not offset the cost of funds, splitting the finance sector is essential to capitalize on cost advantages and gain an edge over banks in the finance sector. When collaborating with manufacturers facing constant output uncertainty, it is advisable to work with those who have relatively low complete output probabilities. This can encourage them to increase their input by lowering both wholesale prices and lending rates, resulting in substantial profits.

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