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Financing strategies of capital-constrained enterprises in a growth market

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KEYWORDS

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ABSTRACT

Capital plays a critical role in supply chain businesses, especially growth enterprises. With respect to a two-echelon supply chain that comprises a core supplier and a capital-constrained retailer with a certain growth potential in the demand market, this study analyzes the supply chain's optimal decision-making and financing equilibrium between debt financing (bank credit financing and trade credit financing) and equity financing (venture capital and strategic investment). We find that both the retailer's valuation level and retail market growth potential have significant effects on the options of financing strategies. Using a Stackelberg game model, the study points out that when only debt financing is viable, the financing equilibrium is trade credit financing; when only equity financing is viable, the financing equilibrium switches from venture capital to strategic investment with an increase in market growth potential; when both debt financing and equity financing are viable, the financing equilibrium under low market growth potential and low valuation is venture capital; the financing equilibrium under low market growth potential and moderate valuation, high market growth potential, and low valuation is trade credit financing; and the financing equilibrium under low market growth potential and high valuation, high market growth potential, and high valuation is strategic investment. This study contributes to the growing body of literature on corporate financing and market expansion. This study has several managerial implications for the financing options of both internal and external investors.

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1. INTRODUCTION

Capital constraints play a key role in managing a firm's operations, particularly for enterprises with growth potential in the demand market. Evidence shows that many capital-constrained growth enterprises went bankrupt because of incorrect financing choices. For example, "Yiding Group," a top 100 chain enterprise in China, declared bankruptcy in December 2015 owing to unreasonable financing options and market expansion. Another example is Luckin Coffee, which has rapidly expanded its consumer market. Most retail divisions face financial constraints and limited financing options when expanding their potential market, which greatly affects the development of Luckin Coffee[1]. However, enterprises such as the Alibaba Group and Xiaomi Corporation have succeeded in adopting reasonable financing strategies during market expansion. For example, "ele.me" in Alibaba Group quickly expanded the potential demand of food delivery service in catering market

[1] https://www.sec.gov/Archives/edgar/data/1767582/000104746919002450/a2238391zf-1.htm

through financing. With the same business expanding its market through financing, why do some enterprises succeed while others fail? Moreover, empirical evidence also shows that once the enterprises seek financing, the financing behavior such as trade credit will significantly affect retailers' inventory decisions and manufacturers' operational decisions, and then further affect the cash flow dynamics within supply chains (Chen et al., 2022)..

discover the reasons for such practices and provide managerial insights into financing strategies in the context of market expansion, this study investigates the financing issues faced by capital-constrained growth enterprises, particularly those in a financing equilibrium between debt financing (DF) and equity financing (EF).

According to Myers and Majluf (1984) and Myers (1984), an enterprise's optimal financing strategy should follow a sequence of endogenous financing, DF, and EF. Owing to the lack of collateral and credit ratings, capital-constrained growth enterprises usually have poor endogenous financing capabilities. Therefore, DF and EF have become the two most popular financing strategies for capital-constrained enterprises with a certain level growth potential. DF has the properties of short term, reversibility, and affordability; that is, the credit obtained by DF needs to be repaid with interest after a specified short time. Evidence shows that bank credit financing (BCF) from external banks and trade credit financing (TCF) from core upstream enterprises are the two most popular DF strategies for financing businesses (Jing et al., 2012; Kouvelis and Zhao, 2012; Cai et al., 2014; Kouvelis and Zhao, 2018; Lu & Wu, 2020). In contrast with DF, EF has the properties long-term irreversibility and unaffordability. That is, the enterprise has no fixed repayment period to repay the credit obtained through EF to investors and only needs to pay dividends. The main strategies for realizing EF are venture capital (VC) from external equity investors and strategic investment (SI) from core enterprises (Kwon et al., 2016; Barrot, 2017; Chakraborty and Ewens, 2018; Huikku et al., 2018; Shao and Sun, 2021).

For a capital-constrained enterprise, equity investors will value the enterprise based on the inherent assets and growth potential before providing EF. Both valuation level and market growth potential have significant effects on EF decisions. For example, for a capital-constrained enterprise with both a low valuation level and market growth potential, equity investors can obtain a high shareholding ratio by providing EF; however, the low market growth potential also reduces the profit level of capital-constrained enterprises, and vice versa. The joint effect of these two factors complicates the optimal financing decisions. Therefore, in this study, we provide a game-theoretic analysis framework to answer two questions.

- How do valuation levels and market growth potential affect the optimal decisions of stakeholders in DF and EF?

- What is the financing equilibrium of capital-constrained growth enterprises between DF and EF, considering market growth potential and valuation level?

We focus on a two-echelon supply chain comprising a core supplier and a capital-constrained retailer with growth potential in the demand market. By considering the market expansion effort, we analyze the impact of market growth potential and the retailer's valuation level on financing decisions and financing efficiency based on the Stackelberg game. In the context of DF, we show that the optimal financing strategy is always TCF even if the supplier's wholesale price under TCF is higher. In the context of EF, we demonstrate that the impact of market growth potential on both suppliers and retailers is complicated owing to the effect of the retailer's valuation level. When both VC and SI are viable in EF, both the retailer and the entire supply chain prefer SI. However, the core supplier provides SI only when the market growth potential is larger. Otherwise, the optimal EF strategy would be VC. Furthermore, we provide the financing equilibrium of a capital-constrained retailer when both DF and EF are viable. The optimal financing strategy is VC under conditions of low market growth potential and low valuation. When either the market growth potential or valuation level increases, the optimal financing strategy switches to TCF and SI when the valuation level is relatively high.

In addition, to the best of our knowledge, this research is the first to study a capital-constrained retailer's financing equilibrium under both DF and EF from the perspectives of market growth potential and retailer's valuation level. In the field of supply chain and corporate finance, the existing literature mainly focuses on financing strategy in the context of considering only DF (Jing et al., 2012; Kouvelis and Zhao, 2018; Wang et al., 2019; Kouvelis and Xu, 2021) or EF (Inderst and Vladimirov, 2019; Fu et al., 2021; Shao and Sun, 2021; Zheng et al., 2021). Previous studies have mainly focused on issues such as contracts (Kouvelis and Zhao, 2012; Inderst and Vladimirov, 2019; Shi et al., 2020), guarantees (Lu et al., 2019; Zhou et al., 2020), financing costs (Kouvelis and Zhao, 2016; Zheng et al., 2021), empirical studies (Barrot, 2017; Chakraborty and Ewens, 2018), and online supply chain finance (Zhang et al., 2023). However, the considerations of random market demand in these literatures are predominantly measured using the newsvendor model, which a framework oriented toward relatively stable market demand. Moreover, prior studies have not examined the impact of retailers' properties on financing decisions from the perspective of supply chain analysis, especially when retailers can expand their efforts to expand their market. Therefore, with the consideration of retailer's efforts to explore market potential in the context of growing market demand, this paper establishes four distinct financing models for capital-constrained enterprises: BCF, TCF, VC and SI, and then financing equilibriums between BCF, TCF, VC and SI are given with the jointly consideration of market growth potential and retailer's valuation level. This analysis offers valuable insights for incentivizing retailers to enhance market expansion, thereby improving product market share and overall supply chain competitiveness, and fills the gap in the literature on marketing, operations management, and enterprise financing.

Using the classic Stackelberg game model, the study provides a comprehensive and systematic characterization of financing equilibrium for capital-constrained firms in growth demand markets by integrating perspectives from both DF and EF. The research also yields several relevant managerial implications for the financing options of capital-constrained enterprises in the context of growing market demand. First, market growth potential and valuation level are two key factors that should be considered when downstream enterprises finance from internal upstream core enterprises or external investors through DF and EF. Second, VC from external investors should be considered only when both the market growth potential and valuation levels are low. Otherwise, capital-constrained enterprises should choose financing from internal core enterprises through TCF or SI.

The remainder of this paper is organized as follows. Section 2 reviews related literature. Section 3 defines the notations, specifies the assumptions, and sequences of events. Section 4 provides an analysis of BCF and TCF in DF. Section 5 provides an analysis of VC and SI in EF. Section 6 discusses the joint impact of market growth potential and valuation level on the financing equilibrium. Finally, section 7 concludes the paper and discusses future research directions.

2. RELATED WORK

Research on corporate financing strategies can be traced back to capital structure theory. The MM theory, proposed by Modigliani and Miller in 1958, highlights that an enterprise's capital structure has no effect on its value in a perfectly competitive market (Modigliani and Miller, 1958). Myers and Majluf proposed the Pecking Order Theory and emphasized that an enterprise's optimal financing strategy should follow the sequence of endogenous financing, DF, and EF (Myers, 1984; Myers and Majluf, 1984). Owing to the lack of collateral and credit ratings, capital-constrained enterprises usually have poor endogenous financing capabilities. Therefore, our study mainly focuses on two streams of literature: DF and EF, especially BCF and TCF in DF, and VC and SI in EF. In this section, we review the related studies on both streams separately.

In the first research stream, existing literatures in DF mainly focused on supply chain finance, which a "win-win" method to provide credit and services to capital-constrained enterprises by converting non-liquid assets into cash (L. Chen et al., 2020). Examples include inventory financing (Buzacott and Zhang, 2004), accounts receivable financing (Vliet et al., 2015; Kouvelis and Xu, 2021), and guaranteed financing (Lu et al., 2019; Zhou et al., 2020), etc. Evidence shows that BCF and TCF are the two most popular financing methods in the DF context. For example, Dada and Hu (2008) design a nonlinear financing mechanism to coordinate a bank- and capital-constrained retailer under BCF. Wu et al. (2018) pointed out that TCF can be used by a manufacturer as a strategic response to the bargaining power of its dominant retailer. Xu and Fang (2020) investigated the impact of partial credit guarantees on decisions on whether to provide TCF. Moreover, from the perspective of upstream unit production costs (Jing et al., 2012), moral hazard (Cai et al., 2014), credit ratings (Kouvelis and Zhao, 2018), and tax savings (Lu and Wu, 2020), the existing literature has studied the optimal financing options between BCF and TCF.

In the second research stream, EF is widely used to finance business of small and medium-sized enterprises that lack fixed assets (Schäfer et al., 2004). From the perspective of model analysis, Kwon et al. (2016) investigated the impact of Bayesian learning and positive or negative externalities on the SI equilibrium in the context of competitive investments with uncertain returns. Barrot (2017) studied the impact of a VC's contractual horizon on investments in innovative firms. Fu et al. (2021) studied third-party logistics firms' EF financing decisions in the context of technological innovation in a platform supply chain. From the perspective of empirical study, Stenback and Tombak (2002) studied the optimal combination of DF and EF in the presence of capital market imperfections and conducted an empirical study based on panel data of 3119 corporations in the Compustat database. Alkaraan and Northcott (2007) explored how pre-decision control mechanisms impact managerial decision-making behavior in SI based on data from a questionnaire survey of 320 large UK companies. Furthermore, based on the empirical data of 108 interviews from among the 150 largest Finnish manufacturing companies, Huikku et al. (2018) emphasized the importance of the adaptations of pre-decision controls in the appraisal of SI. Chakraborty and Ewens (2018) revealed the existence of agency frictions during VC fundraising and highlighted the impact of agency conflicts on investment behavior. Li et al. (2019) examined the impact of the information environment on a firm's financing choice between bank debt and equity. Zheng et al. (2021) investigated the cost of EF capital from the perspective of product market competition and pointed out the impact of tariff rates on financing policy. Shao and Sun (2021) developed a conceptual model to examine how entrepreneurs' social capital facilitates VC for entrepreneurial firms from the perspective of three dimensions of social capital and three stages of financing decisions and verified the results using Chinese enterprises as an experimental setting.

It is worth highlighting the differences between our study and two existing streams of literature. Most existing literature has studied DF or EF from model and empirical perspectives and has mainly focused on issues such as financing contracts design, financing costs, guarantees for financing risks such as default risk and moral hazard in either DF or EF. However, almost no studies have performed a comparative analysis between DF and EF, and the considerations of random market demand are predominantly measured using the newsvendor model. Our work distinguishes itself from existing research in the following critical aspects. First, unlike previous studies focusing solely on BCF or TCF, or the comparisons between BCF and TCF in different scenarios which based on newsvendor model framework, this paper mainly positions BCF and

TCF as fundamental benchmarks to contrast with EF strategies (VC and SI). While this study also examines the financing equilibrium between BCF and TCF, its research context and perspective are positioned within a growth demand market environment. In addition, Inderst and Vladimirov (2019) studied the impact of VC and relationship lending on capital structure options in the context of growth firms. However, they did not consider the effect of DF or the joint impact of market growth potential and valuation level. In a growing demand market, the capital-constrained retailer can expend efforts to expand the market, which will make optimal financing decisions more complicated. Therefore, by integrating perspectives from both debt financing and equity financing, the study provides a comprehensive and systematic characterization of financing equilibrium for capital-constrained firms in growth demand markets with the jointly consideration of market growth potential and retailer's valuation level. The novelty of this study lies in its comparative analysis of DF and EF in a market with growing demand. This study fills a gap in the literature concerning financing options and market expansion in the field of corporate financing.

3. MODEL SETUP

We consider a two-echelon supply chain consisting of a core supplier and capital-constrained retailer, denoted as S and R, respectively. The supplier offers specific products to the retailer at wholesale price w. The retailer faces a growth demand market, exerts effort e to expand the market, and places q orders for these products. The retailer obtains financing using DF (BCF, TCF) or EF (VC, SI). At the end of the sales period, the retailer sells and repays. This study investigates how the market growth potential and the retailer's valuation level impact decision-making and the capital-constrained retailer's financing equilibrium between DF and EF, based on the Stackelberg game.

All notations are summarized in Table 1.

Table 1. Notations

Parameters:	Decision variables:
p: Retailer's unit product retail price in market	w: Supplier's wholesale price
c: Supplier's unit production cost	e: Retailers' efforts to expand the market
θ: Retailer's valuation level	q: Retailer's order quantity
A: Retailer's inherent assets before financing	r: Bank's interest rate
Y: Retailer's internal capital level before financing	Functions:
ξ: Investor's shareholding ratio of the retailer after EF	Π: The expected profit
a: Capacity of retail market	Abbreviations:
b: Price sensitivity coefficient	R: Retailer; S: Supplier
η: Market growth potential	SC: Whole supply chain system
k: Coefficient of effort costs	B: Bank credit financing (BCF)
D: Random demand in retail market	T: Trade credit financing (TCF)
r_f: Risk-free interest rate	VC: Venture capital; SI: Strategic investment

In addition, this study's assumptions are as follows.

1. The bank, supplier, retailer, and external equity investors are all risk-neutral. The bank's market is competitive, and the retailer is limited-ability.

2. All parameters are common knowledge.

3. The retailer only borrows the amount of financing they need to place an order.

4. Without loss of generality, we assume that the retailer's internal capital level before financing is zero ($Y = 0$).

5. Consistent with Cachon and Lariviere (2005), Shunko et al. (2017), we assume the random demand in retail market (D) depends on price and effort, which is expressed as: $D = D(p, e, \varepsilon) = a - bp + \eta e + \varepsilon$, where $\varepsilon \sim N(0, \sigma^2)$, and the effort cost of market expanding is $\frac{1}{2}ke^2$.

The rationale behind Assumption 3 is that excessive financing leads to idle capital and increases the financing costs for the DF. In EF, excessive financing dilutes the shareholding ratio and reduces original shareholders' profits. Additionally, we assume that the retailer's decision-making structure remains unchanged after EF.

In our research model framework, the upstream core supplier is the financing business leader. In other words, the capital-constrained retailer can only choose the financing strategy provided by the supplier. For example, in DF, if it is more profitable for the supplier to provide TCF, a higher wholesale price is decided in BCF, prompting the retailer to choose TCF (Kouvelis and Zhao, 2018). Similarly, in EF, if the supplier believes that it is more beneficial to provide SI, it will decide on a higher wholesale price in the VC and then prompt the retailer to accept its strategic investment.

The sequence of events in both DF and EF are summarized in Table 2.

Table 2. Sequence of events in DF and EF

Debt Financing (DF)	
Bank credit financing (BCF)	Trade credit financing (TCF)
1. The supplier offers a wholesale price. 2. The retailer decides the efforts and orders. 3. Bank sets the interest rate. 4. The retailer pays the supplier in full with bank loans. 5. The supplier produces and delivers the products to the retailer. 6. The retailer sells the products after the market demand realized. 7. The retailer repays loan obligation (if any).	1. The supplier offers a wholesale price. 2. The retailer decides the efforts and orders. 3. The retailer loans credit and products from the supplier. 4. The supplier produces and delivers the products to the retailer. 5. The retailer sells the products after the market demand is realized. 6. The retailer repays loan obligation (if any).
Equity Financing (EF)	
Venture capital (VC)	Strategic investment (SI)
1. The supplier offers a wholesale price. 2. The retailer decides the efforts and orders. 3. The retailer loan cash from external equity investors. 4. The retailer pays the supplier in full. 5. The supplier produces and delivers the products to the retailer. 6. The retailer sells the products after the market demand is realized. 7. The retailer repays dividends to the investors (if any).	1. The supplier offers a wholesale price. 2. The retailer decides the efforts and orders. 3. The retailer loans credit from the supplier as SI. 4. The supplier produces and delivers the products to the retailer. 5. The retailer sells the products after the market demand is realized. 6. The retailer repays dividends to supplier (if any).

As Tables 1 and 2 show, before market demand can be observed (time zero), the supplier offers a take-it-or-leave-it wholesale price w to the retailer at time zero. The retailer then exerts effort e and places q orders with joint consideration of market growth potential and effort costs. The retailer then loans a credit or input of $\frac{1}{2}ke^2$ and wq through DF or EF. Under the BCF in DF, the retailer pays the supplier in full with its external bank loans, the supplier produces the products, delivers orders q_B to the retailer, and the retailer sells the products during the sales period. At the end of the sales period (time one), the retailer repays the external bank for the loan obligation ($\frac{1}{2}ke^2 + wq$). Under TCF in DF, in order to fully develop the demand of growth markets and achieve a "win-win" situation with the capital-constrained retailer, the internal supplier first provide credit support ($\frac{1}{2}ke^2$) to assist the retailer in exploring potential market demand, which subsequently stimulates retailers to increase their order quantities. After the retailer exert efforts in market expansion and determine their order quantity q, the supplier produces products and delivers orders q_T with the retailer's delayed payment. At the end of the sales period (time one), the retailer repays the payment for orders (wq) to the internal supplier.

For EF, we value the retailer using the price-to-book ratio. Then the retailer's valuation before and after EF is θA and $\theta A + wq + \frac{1}{2}ke^2$, respectively. Thus, the investor's shareholding ratio after EF is $\xi = \frac{wq+\frac{1}{2}ke^2}{\theta A+wq+\frac{1}{2}ke^2}$. Under VC in EF, the retailer pays the supplier in full with credit from external equity investors. At the end of the sales period (time one), the retailer repays dividends to investors in ratio ξ. Under the SI in EF, the supplier finances the retailer with amount of $wq + \frac{1}{2}ke^2$ as an equity investment at time zero. At time one, the retailer repays dividends to the supplier in ratio ξ. In contrast to the VC, the supplier's profit comes partly from the dividends paid by the retailer in the SI, which will complicate the supplier's decision.

4. DEBT FINANCING: BANK CREDIT FINANCING AND TRADE CREDIT FINANCING

4.1 Bank credit financing

Under the BCF, the supplier proposes wholesale price w_B and the retailer decides effort level e_B and orders q_B. The retailer then loans a credit amount of $w_B q_B + \frac{1}{2}k(e_B)^2$ to the bank, which grants credit to the retailer with a financing interest rate r_B based on the risk-free interest rate r_f. The decision-making of stakeholders in the supply chain can be formulated as follows.

$$\Pi_B^S(w_B) = \max_{c \le w_B \le p} \{(w_B - c)q_B\} \qquad (1)$$

$$\Pi_B^R(e_B, q_B) = \max_{e_B, q_B} \left\{E_\varepsilon[p\min\{D, q_B\}] - w_B q_B(1 + r_B) - \frac{1}{2}k(e_B)^2(1 + r_B)\right\}^+ \qquad (2)$$

s.t. $q_B = a - bp + \eta e_B$ and (3)

$$\left(w_B q_B + \frac{1}{2}k(e_B)^2\right)(1 + r_f) = \min\left\{\left(w_B q_B + \frac{1}{2}k(e_B)^2\right)(1 + r_B), E_\varepsilon[p\min\{D, q_B\}]\right\} \qquad (3)$$

We proceed backwards to derive the equilibrium and obtain Lemma 1 by integrating Equations (1)-(3). (Hereinafter, for all the proofs, please refer to the Appendix.)

Lemma 1. Under BCF in DF, the optimal solutions are:

(a) The supplier's optimal wholesale price is: $w_B^* = \frac{k(a-bp)}{2\eta^2} + \frac{p}{2(1+r_f)} + \frac{c}{2}$;

(b) The retailer's optimal effort level is: $e_B^* = \frac{\left(p-c(1+r_f)\right)\eta}{2k(1+r_f)} - \frac{a-bp}{2\eta}$; the optimal order quantity is: $q_B^* = \frac{\left(p-c(1+r_f)\right)\eta^2}{2k(1+r_f)} + \frac{a-bp}{2}$;

(c) The bank's optimal interest rate is $r_B^* = r_f$.

Lemma 1 shows that the risk-free interest rate (r_f), market growth potential (η) and market expanding effort cost (k) has a significant effect to the optimal financing decisions, which are summarized in Proposition 1 below.

Proposition 1. Under BCF in DF,

(a) For a given k and η, $w_B^* \propto \frac{1}{r_f}$, $e_B^* \propto \frac{1}{r_f}$, $q_B^* \propto \frac{1}{r_f}$, $r_B^* \propto r_f$;

(b) For a given k and r_f, $w_B^* \propto \frac{1}{\eta}$, $e_B^* \propto \eta$, $q_B^* \propto \eta$, $r_B^* \perp \eta$;

(c) For a given η and r_f, $w_B^* \propto k$, $e_B^* \propto \frac{1}{k}$, $q_B^* \propto \frac{1}{k}$, $r_B^* \perp k$.

Proposition 1 has three implications. First, Proposition 1 indicates that the optimal wholesale price, effort level, and order quantity decrease with the risk-free interest rate, whereas the interest rate increases. The rationale for this is as follows. When the risk-free interest rate is high, the bank will improve the interest rate to ensure its own profit, which will lead to a higher financing cost for the retailer, and thus reduce enthusiasm for market expansion. To induce the retailer to exert greater effort, the supplier will decide on a lower wholesale price to reduce the retailer's ordering cost, thereby offsetting the negative effect of the higher financing cost under a larger financing interest rate.

In addition, the optimal wholesale price decreases with market growth potential and the optimal effort level and order quantity increase with market growth potential; however, the interest rate remains unchanged. The bank is in a competitive market; therefore, the interest rate does not change with factors other than the risk-free interest rate. When the market growth potential is high, the retailer can obtain higher demand under the same effort level. Therefore, the retailer exerts a greater effort and places higher orders. Based on this, the supplier will simultaneously decide on a lower wholesale price to induce a higher effort level and orders, thereby maintaining its profit and the entire supply chain system.

Moreover, contrary to the market growth potential, the optimal wholesale price increases with the effort cost coefficient, the optimal effort level and order quantity decreases with the effort cost coefficient, and the interest rate remains unchanged. Similarly, the retailer bears a higher expansion cost when the cost coefficient increases, which reduces its enthusiasm for market expansion. Unlike the increase in financing costs caused by an increase in the risk-free interest rate in Proposition 1(a), the increase in financing costs comes from the retailer's expansion of market demand. Therefore, the upstream supplier decides on a higher wholesale price to maintain its profit level.

4.2 Trade credit financing

Under TCF, the supplier first announces the wholesale price w_T at time zero, and the retailer then decides the effort level e_T to expand the market. In contrast to BCF, the retailer delays payment. In other words, the retailer pays the supplier at the end of the sales period (Time 1). The decision-making of stakeholders under TCF can be formulated as follows.

$$\Pi_{\mathrm{T}}^{\mathrm{S}}(\mathrm{w_T}) = \max_{c\le w_T\le p} \{min\{E_\varepsilon[pmin\{D,q_T\}],w_Tq_T\} - cq_T\}^+ \qquad (4)$$

$$\Pi_T^{\mathrm{R}}(e_T,q_T) = \max_{e_T,q_T} \left\{E_\varepsilon[pmin\{D,q_T\}] - w_Tq_T - \frac{1}{2}k(e_T)^2\right\}^+ \qquad (5)$$

s.t. $q_T = a - bp + e_T$

Similarly, we derive Lemma 2 by integrating equations (4)-(5).

Lemma 2. Under TCF in DF, the optimal solutions are:

(a) The supplier's optimal wholesale price is $\mathrm{w}_{\mathrm{T}}^* = \frac{k(a-bp)}{2\eta^2} + \frac{p+c}{2}$;

(b) The retailer's optimal effort level is $e_T^* = \frac{(p-c)\eta}{2k} - \frac{a-bp}{2\eta}$; the optimal order quantity is: $q_T^* = \frac{(p-c)\eta^2}{2k} + \frac{a-bp}{2}$.

Similar with Lemma 1 above, Lemma 2 reveals that market growth potential (η) and effort costs (k) has a significant effect to the optimal TCF decisions, which are summarized in Proposition 2 below.

Proposition 2. Under TCF in DF,

(a) For a given k, $w_T^* \propto \frac{1}{\eta}$, $e_T^* \propto \eta$, $q_T^* \propto \eta$;

(b) For a given η, $w_T^* \propto k$, $e_T^* \propto \frac{1}{k}$, $q_T^* \propto \frac{1}{k}$

First, Proposition 2 points out that the optimal wholesale price decreases with market growth potential and that the optimal effort level and order quantity increase with market growth potential. This is because a higher market growth potential improves the retailer's ability to undertake the effort cost of market expansion, which leads to a higher effort level and orders and a lower wholesale price. Next, the optimal wholesale price increases with the effort cost coefficient and the optimal effort level and orders decrease with the effort cost coefficient. Consistent with Proposition 1(c) in BCF, this is because the high effort cost weakens the retailer's enthusiasm for market expansion, resulting in lower orders. Thus, the upstream supplier will decide a higher wholesale price to maintain its own profit level.

4.3 The optimal financing strategy in debt financing

Thus far, we have separately derived the optimal solutions under BCF and TCF in DF by considering the market growth potential. Based on Lemma 1 in Section 4.1, and Lemma 2 in Section 4.2, we further investigate the financing equilibrium for both the supplier and the retailer when both BCF and TCF are viable alternatives.

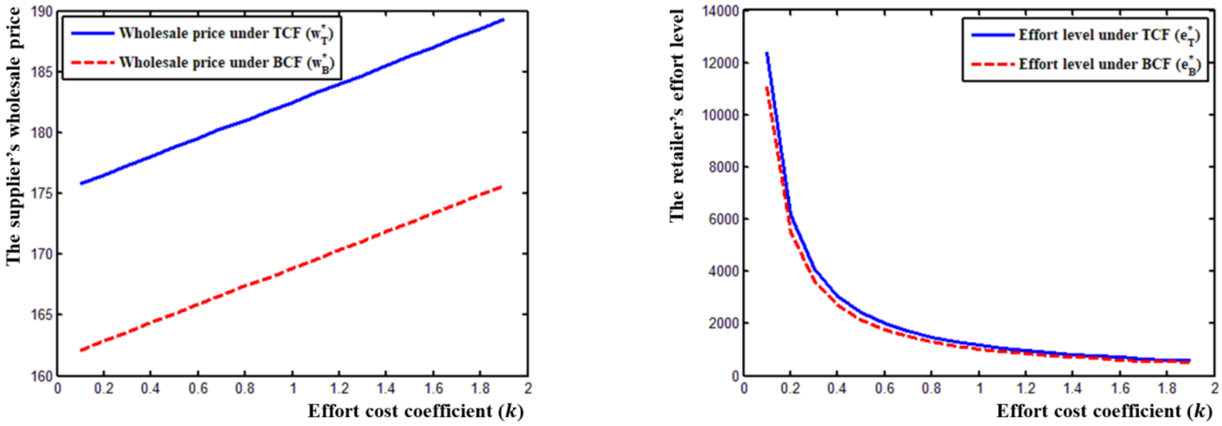
Proposition 3. When both BCF and TCF are viable in DF, $w_B^* \le w_T^*$, $e_B^* \le e_T^*$, $q_B^* \le q_T^*$, $\Pi_{\mathrm{B}}^{\mathrm{S}} \le \Pi_{\mathrm{T}}^{\mathrm{S}}$, $\Pi_{\mathrm{B}}^{\mathrm{R}} \le \Pi_{\mathrm{T}}^{\mathrm{R}}$, the equal sign takes if and only if $r_f = 0$. In other words, the financing equilibrium is TCF in the DF context.

Proposition 3 points out that the supplier's wholesale price, retailer's effort level, and orders under BCF are all lower than those under TCF. In addition, it is worth noting that both the supplier and retailer are more profitable in TCF even with a higher wholesale price, which means both the supplier and retailer are prefers TCF in DF. The rationale for this is as follows. In the context of supply chain with certain growth potential in the demand market, the retailer's effort on market expansion has a significant effect on the orders and profits. In this scenario, the supplier can accurately meet market demand by offering TCF and then reduce the retailer's financing costs or lead to a higher market expansion effort. In addition, under BCF with the participation of external commercial banks, the retailer incurs higher financing costs, especially when the risk-free interest rate is high. Therefore, both the supplier and retailer under TCF without external participation are more profitable in the context of a growth demand market.

We use the following numerical example to illustrate our findings in Proposition 1-3 as follows.

Example 1. We assume that the basic capacity of the retail market is $a = 3000$; the price sensitivity coefficient is $b = 5$; and the product's unit retail price and production cost are $p = 300$ and $c = 50$, respectively.

(1) The risk-free interest rate is $r_f = 0.1$, the market growth potential is $\eta = 10$. The impact of the effort cost coefficient (k) on the optimal financing decisions is shown in Figure 1.



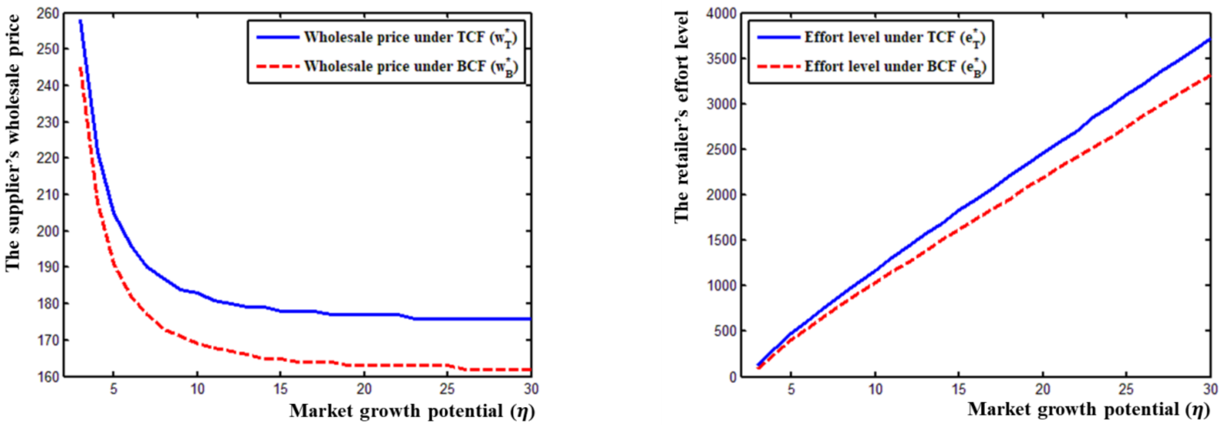
(a) Wholesale price (w_T^*) (b) Effort level (e_T^*)

Figure 1. Impact of effort cost coefficient on the financing decisions in DF

Figure 1 is consistent with Propositions 1(c), 2(b), and 3. In DF, the supplier's optimal wholesale price increases with the effort cost coefficient (Figure 1(a)), the retailer's optimal effort level (orders) decreases with the effort cost coefficient (Figure 1(b)), and the optimal wholesale price and effort level under BCF are lower than those under TCF when $r_f > 0$.

(2) The risk-free interest rate is $r_f = 0.1$, the effort cost coefficient is $k = 1$. The impact of market growth potential (η) on the financing decisions is shown in Figure 2.

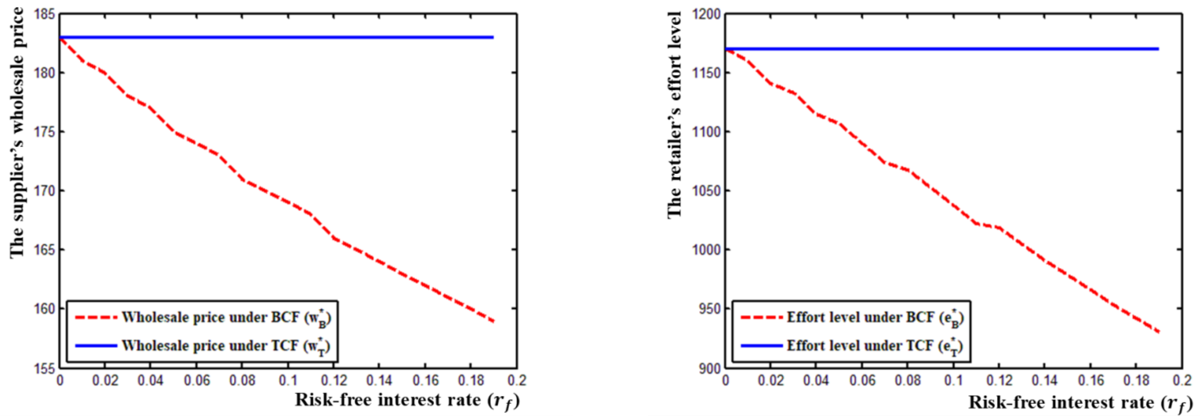
Figure 2 is consistent with Propositions 1(b), 2(a), and 3. In DF, the supplier's optimal wholesale price decreases with market growth potential (Figure 2(a)), the retailer's optimal effort level (orders) increases with market growth potential (Figure 2(b)), and the optimal wholesale price and effort level under BCF are lower than those under TCF when $r_f > 0$.



(a) Wholesale price (w_T^*) (b) Effort level (e_T^*)

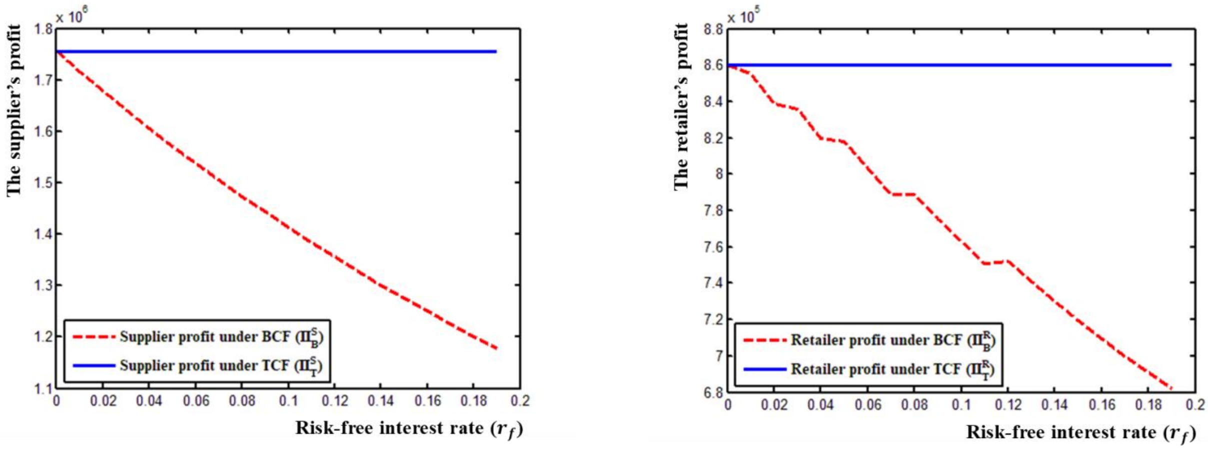
Figure 2. Impact of market growth potential on the financing decisions in DF

(3) The retail market growth potential is $\eta = 10$, the effort cost coefficient is $k = 1$. Figures 3 and 4 show the impact of the risk-free interest rate (r_f) on optimal financing decisions and profits, respectively.



(a) Wholesale price (w_i^*, $i = B, T$) (b) Effort level (e_i^*, $i = B, T$)

Figure 3. Comparison of optimal decisions between BCF and TCF in DF



(a) Supplier's profit (Π_i^S, $i = B, T$) (b) Retailer's profit (Π_i^R, $i = B, T$)

Figure 4. Comparison of optimal profits between BCF and TCF in DF

The results in Figure 3 are consistent with Proposition 1(a). Under BCF, the supplier's optimal wholesale price decreases with risk-free interest rate (see Figure 3(a)), and the retailer's optimal effort level (orders) decreases with risk-free interest rate (Figure 3(b)). Figures 3 and 4 are consistent with Proposition 3. Both the supplier's optimal wholesale price and profit and the retailer's optimal effort level and profit in TCF are higher than in BCF. In other words, TCF is the optimal financing strategy for DF.

5. Equity financing: venture capital and strategic investment

Thus far, we have discussed how the market growth potential affects supply chains' optimal financing decisions and efficiency in DF. However, retailers with a certain growth potential in the demand market often have better development prospects, thus attracting internal and external investors to consider equity investment in capital-constrained retailers. As one of the main ways of corporate financing, EF not only solves the financial difficulties of capital-constrained enterprises, but also enables investors to obtain dividends and bonuses from the market expansion. Therefore, we continue to analyze financing decisions in EF based on the above research framework. In this section, we focus on two EF strategies: VC from external equity investors and SI from internal upstream core suppliers.

Note that the retailer's assets level before and after EF is θA and $\theta A + wq + \frac{1}{2}ke^2$, respectively. Then the equity investor's shareholding ratio after EF is $\xi = \frac{wq+\frac{1}{2}ke^2}{\theta A+wq+\frac{1}{2}ke^2}$, the retailer's original shareholders' shareholding ratio after EF is $1 - \xi = \frac{\theta A}{\theta A+wq+\frac{1}{2}ke^2}$.

5.1 Venture capital by external equity investors

Under VC, the supplier first announces wholesale price w_{VC} at time zero, and the retailer then decides effort level e_{VC} for market expansion and places orders q_{VC}. The decision-making of stakeholders in the supply chain can be formulated as follows.

$$\Pi_{VC}^{S}(w_{VC}) = \max_{c\le w_{VC}\le p} \{(w_{VC}-c)q_{VC}\} \qquad (6)$$

$$\Pi_{VC}^{R}(e_{VC}, q_{VC}) = \max_{e_{VC}, q_{VC}} \left\{(1-\xi_{VC})\left(E_{\varepsilon}[pmin\{D, q_{VC}\}] - w_{VC}q_{VC} - \frac{1}{2}k(e_{VC})^2\right)\right\}^{+} \quad (7)$$

s.t. $q_{VC} = a - bp + e_{VC}$

Similarly, we derive Lemma 3 by integrating equations (6)-(7).

Lemma 3. Under VC in EF, the optimal solutions are:

(a) The supplier's optimal wholesale price is $w_{VC}^{*} = p - \frac{\theta A + p\left(a-bp+\frac{1}{2}\eta e_{VC}^{*}\right)}{\theta A\eta} k e_{VC}^{*}$;

(b) The retailer's optimal effort satisfies: $(\theta A + pN_{VC})(N_{VC} + \eta e_{VC}^{*}) - \frac{1}{2}p(\eta e_{VC}^{*})^2 = \frac{(p-c)\theta A\eta^2}{k}$, where $N_{VC} = q_{VC}^{*} = a - bp + \eta e_{VC}^{*}$.

Lemma 3 indicates that not only the market growth potential (η) and cost of effort (k) has a significant effect to the optimal financing decisions, but also the retailer's valuation level (θ) can affect the decision-making of supplier and retailer in the context of EF, which are summarized in Proposition 4 below.

Proposition 4. Under VC in EF,

(a) For a given θ and η, $w_{VC}^{*} \propto k$, $e_{VC}^{*} \propto \frac{1}{k}$;

(b) For a given θ and k, when $\theta < \hat{\theta}_{VC}$, then $w_{VC}^{*} \propto \frac{1}{\eta}$, $e_{VC}^{*} \propto \eta$; when $\theta > \hat{\theta}_{VC}$, $e_{VC}^{*} \propto \eta$, but there is a threshold $\hat{\eta}_{VC}$, so that $w_{VC}^{*} \propto \frac{1}{\eta}$ when $\eta < \hat{\eta}_{VC}$, and $w_{VC}^{*} \propto \eta$ when $\eta > \hat{\eta}_{VC}$.

First, Proposition 4 points out that the impact of the market expansion effort cost on financing decisions in VC is consistent with Propositions 1-2 in the DF. In both DF and VC, the higher the effort cost coefficient, the higher the wholesale price, and the lower the effort level. The rationale behind this phenomenon is similar to the explanation provided in the DF. Lower market expansion costs can prompt the retailer to exert greater effort to expand the market, thereby improving the supply chain's profits.

However, in contrast to DF in Section 4, Proposition 4 demonstrates that the impact of market growth potential on financing decisions in EF changes with the retailer's valuation level. When the retailer's valuation level is low, the supplier's wholesale price decreases with market growth potential, and the retailer's effort level increases with market growth potential. The rationale behind this finding is consistent with that of the DF. However, when the retailer's valuation level is high, the supplier's wholesale price switches from decrease to increase with market growth potential. This is because the market expansion effect is more sensitive to effort under a high market growth potential. In this scenario, the supplier does not need to promote the retailer's market-expansion efforts through a low wholesale price. Therefore, the supplier decides on a higher wholesale price to maintain a higher profit under higher market growth potential. In addition, a higher valuation level diluted the investors' shareholding ratio in the VC, thus ensuring the retailer's profit. Furthermore, VC investors can benefit from higher market demand even when the shareholding ratio is diluted under this scenario. Therefore, all participants benefit from VC when the retailer has a high valuation and market growth potential.

5.2 Strategic investment by upstream core supplier

Unlike VC, when the upstream core supplier invests equity in the downstream retailer, the supplier's profit will be affected by the retailer. Thus, this will further affect the supplier's decision on the wholesale price and complicate the financing decision-making mechanism under the SI.

In addition, the supplier first announces the wholesale price w_{SI}, then the retailer decides the effort level e_{SI} and q_{SI} in the context of SI. The supplier's and retailer's decision problems can be formulated as Equations (8) and (9), respectively.

$$\Pi_{SI}^{S}(w_{SI}) = \max_{c\le w_{SI}\le p} \{min\{E_{\varepsilon}[pmin\{D, q_{SI}\}], w_{SI}q_{SI}\} - cq_{SI}\}^{+}$$

$$+\xi_{SI}\left(E_{\varepsilon}[pmin\{D, q_{SI}\}] - w_{SI}q_{SI} - \frac{1}{2}k(e_{SI})^2\right)^{+} \qquad (8)$$

$$\Pi_{SI}^{R}(e_{SI}, q_{SI}) = \max_{e_{SI}, q_{SI}} \left\{(1-\xi_{SI})\left(E_{\varepsilon}[pmin\{D, q_{SI}\}] - w_{SI}q_{SI} - \frac{1}{2}k(e_{SI})^2\right)\right\}^{+} \qquad (9)$$

s.t. $q_{SI} = a - bp + e_{SI}$

Where $\xi_{SI} = \frac{w_{SI}q_{SI}+\frac{1}{2}k(e_{SI})^2}{\theta A+w_{SI}q_{SI}+\frac{1}{2}k(e_{SI})^2}$, which denotes the shareholding ratio of the supplier to retailer after SI.

Similarly, we derive Lemma 4 by integrating equations (8)-(9).

Lemma 4. Under SI in EF, the optimal solutions are:

(a) The supplier's optimal wholesale price w_{SI}^* exists and is unique.

(b) The retailer's optimal effort level e_{SI}^* satisfies: $\left(\theta A + p\left(a - bp + \frac{1}{2}\eta e_{SI}^*\right)\right)ke_{SI}^* = (p - w_{SI}^*)\theta A\eta$; the optimal order quantity is $q_{SI}^* = a - bp + \eta e_{SI}^*$.

As shown in Lemma 4, the optimal wholesale price under SI has no specific analytical solution because of the joint and complicated effects of effort and the shareholding ratio. In order to analyze the impact of market growth potential (η), market expansion effort cost (k) and retailer's valuation level (θ) on the retailer's effort level and orders, we weaken Lemma 4 by assuming that the supplier do not participate in the decision of supply chain operations in SI, that is, the supplier maintains a fixed wholesale price. We then deduce Corollary 1 as follows:

Corollary 1. Under SI in EF, if the supplier maintains a fixed wholesale price, then

(a) For a given θ and η, $e_{SI}^* \propto \frac{1}{k}$, $q_{SI}^* \propto \frac{1}{k}$;

(b) For a given θ and k, $e_{SI}^* \propto \eta$, $q_{SI}^* \propto \eta$;

(c) For a given η and k, $e_{SI}^* \propto \theta$, $q_{SI}^* \propto \theta$.

Corollary 1 provides the following conclusions. First, both the retailer's market expansion effort and orders decrease with the coefficient of effort costs and increase with market growth potential. This is consistent with Propositions 1-2 in the DF, and Proposition 4(a) in the VC. In addition, the retailer's effort level and order increase with the valuation level. This is because a higher valuation level reduces the dividends that the retailer should pay to the investors (supplier) so that the retailer keeps a larger proportion of the entire supply chain's profit and then promotes the retailer's enthusiasm for market expansion.

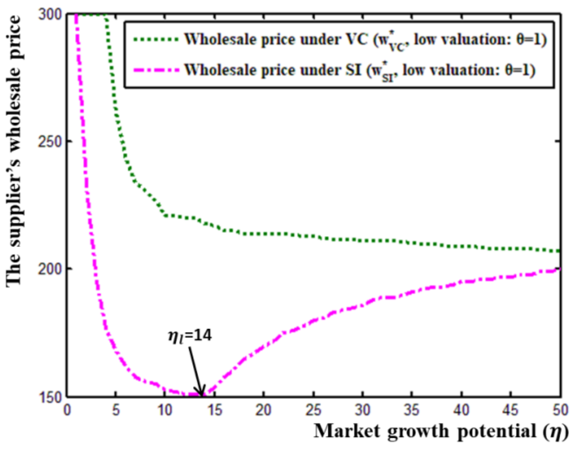
5.3 The optimal financing strategy in equity financing

In this section, we analyze the optimal EF strategy between the VC and the SI. Note that the optimal wholesale price under SI has no specific analytical solution; therefore, a numerical simulation is used in this section to analyze the joint impact of the retailer's valuation level and market growth potential on the financing equilibrium in EF.

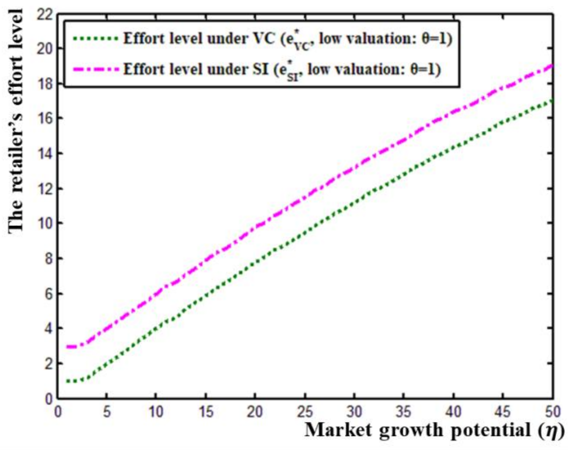
5.3.1 Low valuation level

We assume $\theta = 1$, that is, the retailer's valuation is equal to its inherent assets before financing. In this case, the retailer is undervalued. We conduct the following numerical simulation to explore the impact of the market growth potential on optimal EF strategies at a low valuation level.

Example 2. We assume that the basic capacity of the retail market is $a = 3000$; the price sensitivity coefficient is $b = 5$; and the product's unit retail price and production cost are $p = 300$ and $c = 50$, respectively. The effort cost coefficient is $k = 1$. We then plot the impact of the retail market growth potential on optimal financing decisions and profits in VC and SI in Figures 5 and 6, respectively.

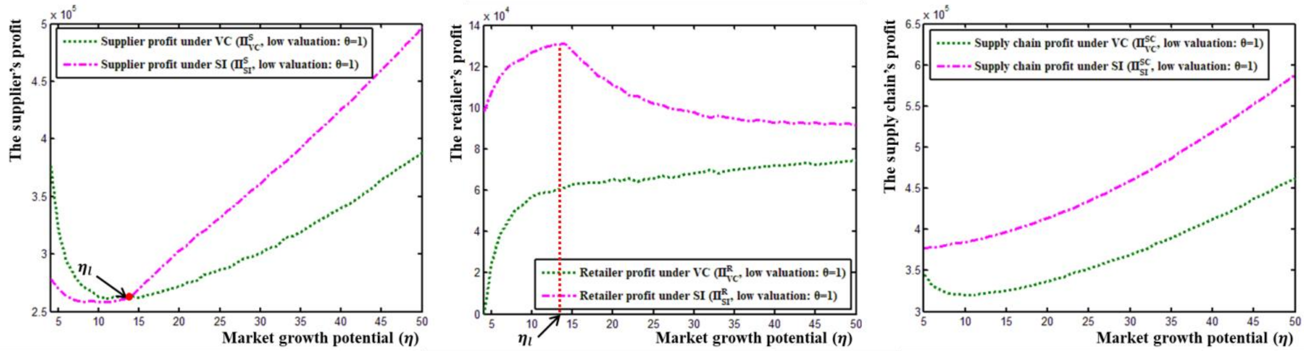


(a) Wholesale price (w_i^*, $i = VC, SI$)



(b) Effort level (e_i^*, $i = VC, SI$)

Figure 5. Comparison of optimal decisions between VC and SI (low valuation level)



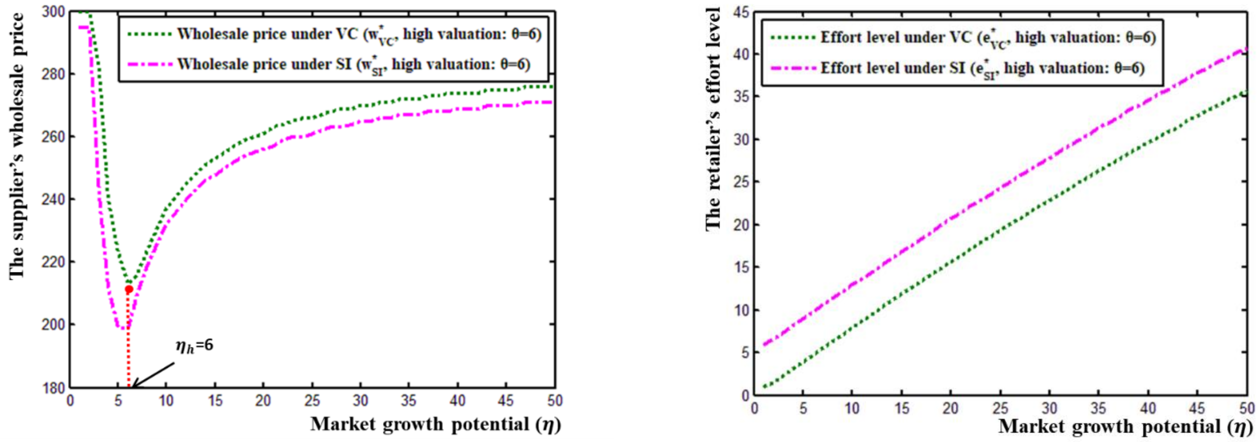
(a) Supplier's profit (b) Retailer's profit (c) Whole supply chain's profit

Figure 6. Comparison of optimal profits between VC and SI (low valuation level)

Figure 5 is consistent with Proposition 4, When the retailer's valuation level is low, the supplier's optimal wholesale price under VC decreases with market growth potential (Figure 5(a)), and the retailer's optimal effort level (and orders) under VC increases with market growth potential (Figure 5(b)). Additionally, the supplier's optimal wholesale price under VC is higher than that under SI, but the retailer's optimal effort level (and orders) under VC is lower. Furthermore, Figure 6 reveals that both the retailer and supply chain prefer SI in EF. However, the supplier offers SI only when the market growth potential is relative high ($\eta > \eta_l = 14$). The rationale for this is as follows. The supplier's profit comes partly from the retailer's dividends under SI. Hence, the supplier will decide on a lower wholesale price to weaken the retailer's ordering cost and promote the retailer's efforts to expand the market. This decision-making behavior makes the retailer and entire supply chain more profitable under SI. However, the supplier's decision to provide an SI with a lower wholesale price reduces its profit. Therefore, only when the market growth potential is high can the supplier benefit from a higher order quantity and choose to provide SI in EF.

5.3.2 High valuation level

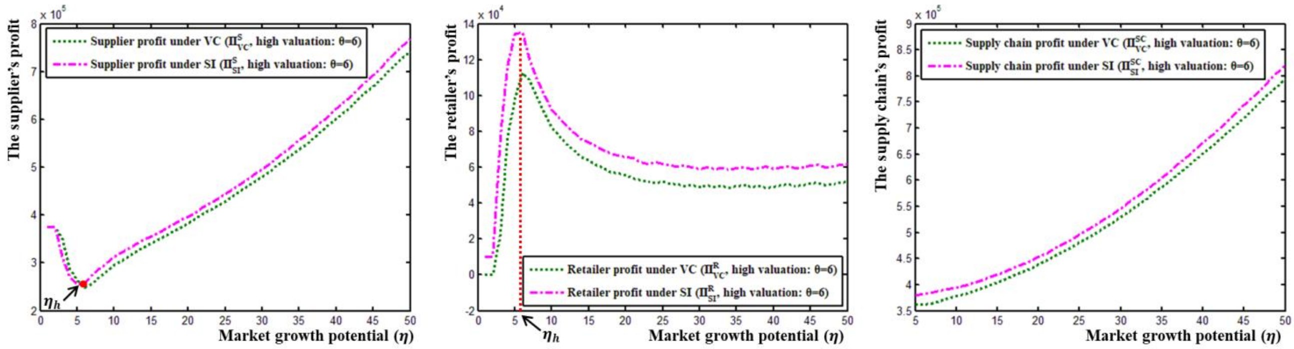
We assume $\theta = 6$ in this scenario, which is much larger than the price-to-book ratio of the listed retail industry[2]. Therefore, the retailer is overvalued. Similarly, we conduct Example 2 to explore the impact of market growth potential on optimal EF strategies at a high valuation level. The results are shown in Figure 7 and Figure 8.



(a) Wholesale price (w_i^*, $i = VC, SI$) (b) Effort level (e_i^*, $i = VC, SI$)

Figure 7. Comparison of optimal decisions between VC and SI (high valuation level)

[2] As of June 2, 2017, the price-to-book ratio (valuation level) of the retail industry listed on the China A-share market was only 2.22.



(a) Supplier's profit (b) Retailer's profit (c) Whole supply chain's profit

Figure 8. Comparison of optimal profits between VC and SI (high valuation level)

Figure 7 is consistent with Proposition 4, When the retailer's valuation level is high, the supplier's optimal wholesale price in the VC switches from decreases to increases with the market growth potential (Figure 7(a)), and the retailer's optimal effort level (and orders) in the VC increases with market growth potential (Figure 7(b)). Additionally, the supplier's optimal wholesale price under VC is higher than that under SI, and the retailer's optimal effort level (and orders) under VC is lower. Furthermore, Figure 8 reveals that both the retailer and the supply chain also prefer SI in EF when the retailer's valuation level is high, and the supplier offers SI only when the market growth potential is relative high ($\eta > \eta_h = 6$). The rationale behind this is consistent with the above scenario in which the retailer's valuation level is low. However, different with low valuation level, the core supplier tends to provide SI with relatively low requirements for the market growth potential under high valuation level (i.e., $6 = \eta_h < \eta_l = 14$). This is because a higher valuation level dilutes the shareholding ratio of the supplier to the retailer after SI, thereby weakening the effect of market growth potential on the supplier's decision making.

From the above numerical analysis, we can conclude the financing equilibrium between the VC and SI in EF as in Proposition 5 below.

Proposition 5. When both VC and SI are viable in EF, $\Pi_{VC}^{R} < \Pi_{SI}^{R}$, $\Pi_{VC}^{SC} < \Pi_{SI}^{SC}$. And there exists a threshold $\hat{\eta} \propto \frac{1}{\theta}$, then $\Pi_{VC}^{S} > \Pi_{SI}^{S}$ when $\eta < \hat{\eta}$; otherwise, $\Pi_{VC}^{S} < \Pi_{SI}^{S}$ when $\eta > \hat{\eta}$.

Proposition 5 indicates that the optimal EF strategy switches from VC to SI with an increase in market growth potential. In addition, the requirement for market growth potential when the supplier provides SI decreases with the valuation level. In other words, the core enterprise in the supply chain prefers to make SI to capital-constrained enterprises with higher valuation levels. The rationale behind Proposition 5 is as follows. The retailer affects the supplier's profit in the SI context. Thus, the supplier can increase the retailer's profit by lowering the wholesale price and improving the efficiency of the supply chain operations. Therefore, the supplier prefers a demand market with high growth potential to offset the loss caused by the lower wholesale price. Thus, the supplier chooses to provide SI under high market growth potential. Furthermore, the supplier's shareholding ratio to the retailer after SI decreases with the retailer's valuation level, thereby weakening the effect of growth potential on the supplier's decision-making. Therefore, the supplier offers an SI with a lower market growth potential in the context of a higher retailer's valuation level.

6. Financing equilibrium of in growth demand market

When either DF or EF is viable, we derived the optimal solutions for each scenario separately in Sections 4 and 5, respectively. In Section 4, we show that TCF is the optimal financing strategy for BCF and TCF in DF. In Section 5, we point out that the optimal financing strategy for VC and SI in EF depends on market growth potential and the retailer's valuation level. In this section, we investigate the financing equilibrium between DF and EF by considering both market growth potential and the retailer's valuation level.

Similar to Section 5.3, we continue using numerical simulations to analyze the financing equilibrium for the capital-constrained retailer, because the optimal wholesale price under SI has no specific analytical solution.

6.1 Financing equilibrium under a low market growth potential

We assume $\eta = 8$ in this scenario, that is, the retail market has a low growth potential. We conduct the following numerical simulation to explore the impact of the retailer's valuation level on the optimal financing strategy between DF (TCF) and EF:

Example 3. We assume that the basic capacity of the retail market is $a = 3000$; the price sensitivity coefficient is $b = 5$; and the product's unit retail price and production cost are $p = 300$ and $c = 50$, respectively. The effort–cost coefficient is $k = 1$. We then plot the impact of the retailer's valuation level on the supplier's profit in Figure 9.

In the scenario in which the growth potential of the demand market is low, Figure 9 indicates that the retailer's optimal financing strategy switches from VC to TCF and, finally, to SI with an increase in the retailer's valuation level. The rationale for this is as follows. First, as shown in Proposition 5, the supplier cannot benefit from offers TCF or SI to the retailer when both the market growth potential and retailer's valuation level are low ($\eta = 8$, $\theta < 1.49$). Therefore, the retailer can finance only through the VC provided by external equity investors. With the increase of retailer's valuation level ($1.49 < \theta < 2.7$), the retailer has difficulty in obtaining financing through VC owing to the decrease of shareholding ratio of VC investors, and then weakens the retailer's enthusiasm for market expansion. Thus, TCF is outperformed because the retailer's valuation level does not affect the supplier's profit. However, if the retailer's valuation level is relatively high ($\theta > 2.7$), the decline in the dividends rate paid by the retailer under SI has improved the retailer's enthusiasm for market expansion, thus promote the supplier choose to provide EF through SI.

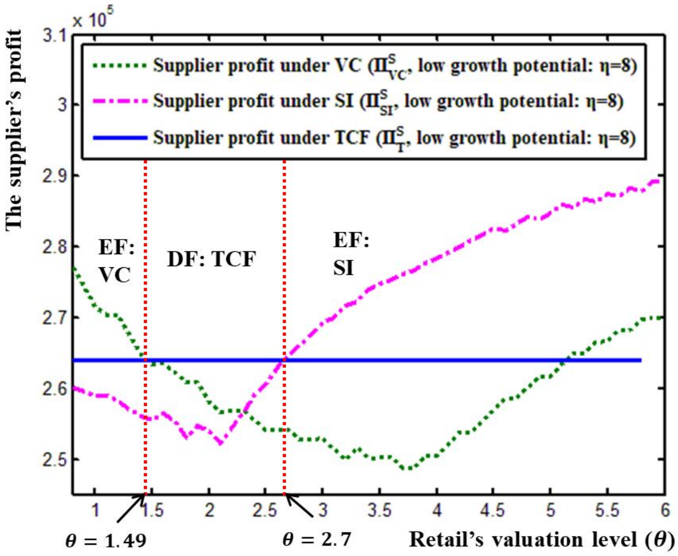


Figure 9. Comparison of the supplier's profit between DF (TCF) and EF (low market growth potential)

In the scenario in which the growth potential of the demand market is low, Figure 9 indicates that the retailer's optimal financing strategy switches from VC to TCF and, finally, to SI with an increase in the retailer's valuation level. The rationale for this is as follows. First, as shown in Proposition 5 above, the supplier cannot benefit from offers TCF or SI to the retailer when both the market growth potential and retailer's valuation level are low ($\eta = 8$, $\theta < 1.49$). Therefore, the retailer can finance only through the VC provided by external equity investors. With the increase of retailer's valuation level ($1.49 < \theta < 2.7$), the retailer has difficulty in obtaining financing through VC owing to the decrease of shareholding ratio of VC investors, and then weakens the retailer's enthusiasm for market expansion. Thus, TCF is outperformed because the advantage that the supplier's profit is not affected by the retailer's valuation level. However, if the retailer's valuation level is relatively high ($\theta > 2.7$), the decline in the dividends rate paid by the retailer under SI has improved the retailer's enthusiasm for market expansion, thus promote the supplier choose to provide EF through SI.

6.2 Financing equilibrium under a high market growth potential

We assume $\eta = 30$ in this scenario, that is, the retail market has a high growth potential. Similarly, we conduct Example 3 again in Section 6.1 to explore the impact of the retailer's valuation level on the optimal financing strategy between DF (TCF) and EF. The results are presented in Figure 10.

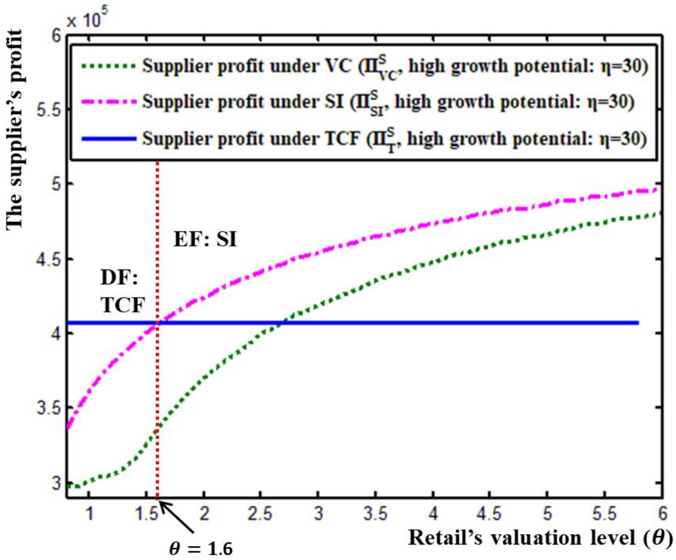


Figure 10. Comparison of the supplier's profit between DF (TCF) and EF (high market growth potential)

When the growth potential of the demand market is high, Figure 10 indicates that the retailer's financing equilibrium switches from TCF to SI with an increase in the retailer's valuation level. Different with the financing equilibrium in a low market growth potential, it is noteworthy that there is no equilibrium that VC is the optimal financing strategy in the context of high market growth potential. The main reason for this is that suppliers can always benefit from providing credit if the growth potential of the demand market is high. When the retailer's valuation level is low ($\theta < 1.6$), TCF is the optimal financing strategy owing to the supplier's profit is not affected by the valuation level. When the retailer's valuation level continues to increase, the supplier adjusts the financing strategy to the SI to benefit from the high market growth potential through dividends. Additionally, consistent with Proposition 5 above, the threshold of retailer's valuation level under high market growth potential is lower (i.e., $\theta = 1.6 < 2.7$), which means that the supplier prefers to offer SI to capital-constrained retailer with high market growth potential and valuation level.

6.3 Financing equilibrium in growth demand market

We conclude the financing equilibrium of capital-constrained enterprises in the growth-demand market between DF and EF, as shown in Table 3.

As shown in Table 3, when both DF and EF are viable, if both the market growth potential (η) and retailer's valuation level (θ) are low, the optimal financing strategy is VC in EF; if the growth potential (η) is low and the valuation level (θ) is moderate, or the growth potential (η) is high and the valuation level (θ) is low, the optimal financing strategy is TCF in DF; if the growth potential (η) is low and the valuation level (θ) is high, or the growth potential (η) is high and valuation level (θ) is moderate or high, the optimal financing strategy is SI in EF.

Table 3. Financing equilibrium in growth demand market between DF and EF

market growth potential ($\boldsymbol{\eta}$)	retailer's valuation level ($\boldsymbol{\theta}$)	financing equilibrium
low	low	EF: VC
low	moderate	DF: TCF
high	low	
low	high	EF: SI
high	moderate, high	

5. CONCLUSION

Debt financing (DF) and equity financing (EF) are the two main financing strategies used in the context of corporate financing, particularly for capital-constrained retailers in a growth demand market. Using a Stackelberg game model, this study investigates the joint impact of market growth potential and retailers' valuation levels on optimal financing decisions and the equilibrium between DF (bank credit financing, BCF; trade credit financing, TCF) and EF (venture capital, VC;

strategic investment, SI). We find that the optimal financing strategy is TCF when only DF is viable. Additionally, both the retailer and the entire supply chain prefer SI in EF. However, the core supplier offers SI only when the market growth potential is large. Therefore, the optimal financing strategy switches from VC to SI with an increase in the market growth potential when only EF is viable. Furthermore, when both DF and EF are viable, our analysis indicates that VC is the optimal financing strategy under low market growth potential and low valuation levels. When either the market growth potential or valuation level increases, the optimal financing strategy switches to TCF or SI.

From the perspective of supply chain analytics, our study provides managerial guidance for capital-constrained divisions regarding corporate financing decisions and options in a growth demand market. First, the market growth potential and valuation level should be considered when capital-constrained enterprises finance internal core enterprises or external investors. Additionally, in a growth-demand market, VC from external investors should be considered only when both market growth potential and valuation levels are low. In contrast, capital-constrained enterprises should choose financing from internal core enterprises.

Finally, we conclude by discussing possible extensions to our current model. First, due to the lack of full information about the capital-constrained retailer, moral hazard arises, as retailers might divert credit to other projects (especially in DF). This hidden action prompts creditors to cap their credit size to avoid substantial financial risk. Future research should consider moral hazards and explore additional managerial insights. Second, the retailer sometimes has more precise knowledge of the demand conditions. The financing equilibrium in channels with such asymmetric information is worth analyzing. Finally, we identify optimal financing strategies. However, this has not yet been studied empirically. Therefore, collecting industry evidence to validate our theoretical findings is a priority for future studies.

6. ACKNOWLEDGMENTS

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Conflicts of Interest

We declare that there are no conflicts of interest related to this study..

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