STRATEGIC PRICING WITH IMITATIVE ENTRY IN THE PRESENCE OF RATIONAL CONSUMER BEHAVIOR

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ABSTRACT

Imitative products are evident and pervasive around the global market. This study aims to investigate the impact of imitative products on the profitability of an innovator in the presence of the strategic consumer behavior in a two-period framework. Our results show that rather than deterring the imitative entry as recommended by most previous literatures, it is better for the innovator to tolerate it especially when consumers’ acceptance of imitation is very high or the imitation cost is sufficiently low. Surprisingly, the tolerated imitative entry may enhance the innovator’s profitability. Furthermore, we find that the innovator may obtain more benefits from tolerating the imitative entry than charging a licensing fee or introducing a low-end product itself.

Keywords: Imitative Product, Dynamic Pricing, Rational Consumer Behavior

INTRODUCTION

Imitative products that intentionally mimic the logo, the function, or the design of innovative brands are evident and pervasive in many industries, ranging from luxury fashion goods (e.g., watches, designed garments, and leather items) to high-tech consumer electronics (e.g., cell phones, computers, automobiles and stereo equipment). Taking cell phone market as an example, the Financial Times estimated that imitative phones accounted for about 20% of the global 2G mobile market in 2010 (Brothersoft, 2011). A huge saving on the investment in innovation and design is obviously an economic incentive for imitators (Shenkar, 2010). In recent years, the widely development of Internet fosters the growth of imitative products (New York Times, 2011). While most information about the design or characteristics of products can be easily accessed online, the barriers for small business owners, even amateurs, to copy the brand-name products are largely reduced. On the other hand, the ease of obtaining information also facilitates the consumers to find an imitative substitute for a well-known but expensive product they like.

“When Steve and Grace Hassid need a new kitchen table or bookshelf, they browse online catalogs of chains such as Room & Board and Crate & Barrel—and then get the pieces custom-made for half the price.” That custom-made furniture can be easily ordered from stores like Sphere Designs or Furniture Envy which “copy designs from popular chain stores such as Pottery Barn for a big discount”. Although there are some complaints about the quality and long waiting time, many consumers are satisfied with the copycat furniture store since “it allows them to have modern design on a budget” (Wall Street Journal 2010).

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As the instance shows, despite of being inferior, imitative products are appealing to certain consumers for their more affordable prices (Schnaars, 1994). The former head of design at US-based Fossil watches Enrico Margaritelli categorizes a consumer into two categories: a fashion consumer or a high-end consumer, where the fashion consumer “typically looks for a well-known luxury brand name and a close imitation to that brand’s most popular style at a reasonable price point” (Forbes, 2013). This indicates that imitators can potentially encroach on the market shares of innovators. Under the threat of imitative entry, the literature predominantly suggests that innovating firms should take serious actions to deter imitative competitors and prevent their profit pools from being diluted. Several defensive strategies have been proposed. Indeed, unless under positive network externality environment where imitative products can help expand the market potential (Conner, 1995), one can hardly imagine that being imitated can have another silver lining for innovating firms. While this remark makes intuitive sense, it may possibly be challenged, as the role of strategic consumer behavior has been consistently ignored in prior studies. This paper focus on how the imitative product influences the profitability of the innovator it imitates when consumers are strategic. While consumers play a momentous role in the strategic interactions between innovators and imitators, our views on the economic impact of imitative entry may significantly change when the strategic consumer behavior towards intertemporal choice enters the picture.

What is it relevant to consider the strategic consumer behavior? Most innovative products are durable in nature. In selling a durable good, convention wisdom suggests that a monopolist can offer subsequent markdowns to intertemporally price discriminate consumers who differ in their product valuations. This is true when consumers are reactive to current prices in making trade-offs between present versus future consumption. However, consumers are often strategic. In the presence of strategic consumers who are forward-looking, the seminal work of Nobel laureate Ronald Coase (1972) conjectures that if a monopolist is ex ante unable to make binding commitments about future prices, the monopoly pricing power may disappear in the “twinkling of an eye.” This conjecture has motivated voluminous subsequent studies on durable good pricing to more carefully accommodate consumers’ intertemporal choice behavior.

While some customers may strategically and patiently wait for future price reductions, they may at the same time anticipate imitative entries and postpone their consumption decisions until an acceptable alternative within their budget range is available. Thus, failing to consider the strategic consumer behavior may leave prior studies on imitative entry unable to provide effective guidance. In the furniture example, customers order the copycat furniture normally need to wait eight to ten weeks for the store to imitate the ready-made stuff that they desire. This time lag between innovative and imitative products is not alone in the furniture market. A similar phenomenon can be seen elsewhere. In response to its later imitative entry, should the innovator adopt different product and pricing strategies when facing strategic customers, as compared to reactive ones? What is the theoretical impact of imitative threat on the innovator’s profitability? Whether innovators should deter or accommodate imitative entry, and whether the existence of imitative products is socially desirable? How to design a proper policy on patents and intellectual property rights with regard to when a tighter anti-piracy law should be called for?
To rigorously address these questions, we propose a two-period model to analyze the dynamic interaction between the innovator and an imitator. Specifically, after choosing the quality level of its new product, the innovator dynamically sets a price for each selling period. No binding commitments about future price can be ex ante made. While acting as a monopolist in the first period, the innovator faces competitive entry of the imitator in the second one. The imitator, if decides to enter, will clone the innovation and determine the quality level of the imitative product. The imitator also reacts to the innovator’s product and pricing strategies by setting a competitive price. All consumers arrive at the outset and strategically make trade-offs between present versus future consumptions. They also compare the benefits of buying from the innovator against that from the imitator. We start with the analysis of the innovator’s decisions as a monopolist. This analysis provides the possible pricing strategies the innovator may adopt if the consumers are forward-looking, and sets a benchmark for the subsequent analysis in the presence of imitative entry.

Our result reveals that when the imitation cost is low or consumers have a high acceptance level on the imitative product, the innovator prefers to accommodate the imitative entry rather than deterring it as suggested by most previous literatures. Surprisingly, if the imitative entry is tolerated, the innovator may earn more profits than the maximum it can earn in the absence of imitation. Without the imitative product, when the innovator intents to target on the profitable high-end consumers only, it may intentionally distort its quality level due to the problem of convincing the consumers of its dynamic price consistency (Hahn, 2004). If there is an imitative entry, the high segment consumers’ expectation on a future discount would be reduced since the low-end market is not that attractive to the innovator. This reduction in expectation enables the innovator to target on the profitable customers with an efficient quality level and thus enhances the innovator’s profits. One can see this result in the way that the threat of imitative entry increases the innovator’s ability to make credible commitment to future prices which is always desirable. In this paper, we characterize the conditions that under which the imitative product benefits the innovator to provide impactful implications for innovating firms and policy makers regarding how to deal with the threat of imitative activities.

The remainder of paper is organized as follows. After reviewing the related literatures in the following section, Section 3 develops the model and presents the analysis of a monopolist innovator to establish a benchmark. Section 4 extends the model to a competitive environment to explore the impacts of imitative entry on the innovator’s pricing strategy, quality decision and profitability. Subsequently, we generalize our model in Section 5 by discussing the innovator’s choice of licensing fee and fighting low-end brand as defenses to the imitative product. Finally, the results are concluded in Section 6.

**LITERATURE REVIEW**

Research on the impact of imitative products has been extensively conducted (see Zaichkowsky, 1995 for a comprehensive review). In most of the studies, imitative entry is considered to be detrimental for a variety of reasons, including that it encroaches on the market share of the incumbent firm (Grossman and Shapiro, 1988a; Qian, 2007), adds the negative externality on consumers who purchase the generic product (Grossman and Shapiro 1988b), and inhibits the incumbent’s transfer of technology to lower cost location (Fosfuri, 2000; Sun et al., 2010).
Various strategies thus have been proposed to deter potential imitative rivals from the perspective of innovating firms (Pepall & Richards, 1994; Pepall, 1997; Sun et al., 2004, Laurent, 2008; Zhang et al., 2009; Cho et al., 2010). On the other hand, however, it is empirically evident that imitative entry is not always harmful to innovating firms (Wilke & Zaichkowsky, 1999; Trott & Hoecht, 2007; Minagawa et al., 2007). To explain why, Conner (1995) shows that in the presence of network externality, an innovating firm can possibly benefit from being imitated because imitative products help to build up the user base for the innovator's technology by bringing more consumers into the market. From a different perspective, Bessen & Maskin (2009) demonstrate that the imitation may work as a valuable complementary, and may thus help to enhance the innovator’s sequential invention. While the models and the contexts vary across the studies on imitative entry, none of the studies along this line work the interaction between innovators and imitators in a dynamic framework.

There are some prior literatures devote on uncovering the influence of a competitive rivalry on the incumbent in a dynamic environment (e.g. Eliashberg & Jeuland, 1986; Dockner & Jorgensen, 1988; Xie & Sirbu, 1995). Among these papers, however, the consumers’ intertemporal substitution between incumbent and later entered products is not included, which concerns this study. When consumers are strategic, they decide not only which product to buy but also when to buy. By considering strategic consumer behavior toward intertemporal choice, the later entrant would alter the incumbent’s strategy to a greater extent. For example, Purohit (1994) shows that if there is a potential clone product the incumbent chooses a higher innovation level and is more reluctant to leapfrog its old product or shelve its new product compared to the case with no threat of entry. Different with the new product introduction strategies examined in Purohit (1994), the central concern of this paper is how the incumbent’s pricing strategy is affected by the later competitive entrant in the presence of strategic consumers, which might complement to this branch of research.

Numerous models have been developed to investigate intertemporal pricing strategies of durable goods with strategic consumer behavior (e.g., Stokey, 1979, 1981; Bulow, 1982; Moorthy, 1988; Besanko & Winston, 1990). This research stream is inspired by Coase (1972) who first argues that a monopolist, if unable to make a credible commitment on the future prices of its product, will gain no profit margin when consumers strategically expect subsequent markdowns in the future. The problem underlying the credibility issue of intertemporal commitment is known as time inconsistency (i.e., the original best decision for some future period is inconsistent with what is preferred when that future period arrives). To alleviate the time inconsistency problem, a variety of mechanisms have been proposed. These include leasing strategy that rents the sellers’ output to consumers instead of selling (Bulow, 1982), planned obsolescence that eliminates the secondhand market by introducing new units of output that make old units obsolete (Bulow, 1986; Waldmen, 1993), best price provision which provides reimbursement to consumers who observe a lower price in the future (Butz, 1990), proportional rational scheme that first serves the low-end consumers to guarantee a higher price in the second period (Denicolo & Garella, 1999), and the maintenance market monopolizing realized by exclusively possessing the used product consumption (Morita & Waldman, 2004). In addition, Arya & Mittendorf (2006) argue that strategically decentralizing a distribution channel can mitigate the time inconsistency problem. Until now, this stream of research is mainly developed in the monopolist environment where the
consumers’ intertemporal evaluation of the alternatives between a currently available product and the one in the pipeline has been ruled out. This work aims to fill in this gap.

**MONOPOLY MODEL**

Consider a two-period model in which an innovator develops a new product to a market in the first period and an imitator, who clones the innovation invented by the innovator, may enter the market in the second period. Different from most studies in the imitative entry literature, wherein the competition between the innovator and the imitator is modeled in a single-period static framework (e.g. Conner, 1995; Pepall, 1997; Sun et al., 2010); we propose a two-period dynamic approach to model the relevant strategic interactions. This two-period stylization, which essentially captures the time lag between the innovation and imitation, is motivated by a more realistic observation that the imitative product is not available for sale until after the innovative product has been on the market for a certain while (Mansfield, 1985).

In this section, we start with analyzing the innovator’s decisions in a monopoly framework, where no imitation is considered to clarify some insights.

**Consumers**

The market consists of two types of customers who differ in their intensity of preference for the quality: high (H) and low (L) types. Note that to enable alternative interpretations, as justified in Appendix A, we can instead assume here that the market consists of wealthier versus less wealth types with a concave income utility function. The market size is normalized to unity and the fraction of type H is $\alpha$. Denote $V_i(q)$ to be type $i$’s valuation for quality level $q$; $V_H(q) > V_L(q)$ for all $q > 0$. Consumers are consistent with respect to their ordinal preference on the product quality. While a higher quality level yields a higher product valuation to all consumers, type H cares more about quality, i.e., $V_H'(q) > V_L'(q) > 0$ for all $q > 0$. So as to reveal the fundamental structure of our analysis and obtain concrete results in a more explicit way, we adopt the common assumption of constant marginal valuation for quality (Mussa & Rosen, 1978). In particular, let $\theta$ be defined as the relative marginal valuation for quality of type H versus type L; that is, $\theta = V_L'(q)/V_H'(q)$. Since the quality level and the cost function can be rescaled, entailing no loss of generality, we standardize $V_H'(q)$ to 1. It follows that $\theta \in (0,1)$. Obviously, the parameter $\theta$ governs the degree of consumer heterogeneity in taste for quality (or wealth level); a lower value of $\theta$ signifies a higher degree of heterogeneity.

All consumers arrive at the outset and rationally make trade-offs between present versus future consumptions. Utility maximization principle predicts that a consumer will purchase in the first period if the resulting surplus exceeds that from purchasing in the second one and is non-negative. If buying in the first period is not justifiable, a consumer buys in the second period when doing so yields a non-negative surplus. When making the intertemporal choice, consumers may perceive a disutility from waiting for future consumption. To capture this disutility, we impose a discount factor to the utility of buying in the second period. This discount factor is
denoted by $\delta \in [0,1]$ and called the *patience level* of future consumption. A lower $\delta$ implies a higher disutility from future consumption.

**Innovator’s Possible Pricing Strategies**

As a sole seller in the market, the innovator first chooses the quality level of its product $q$, and then dynamically sets prices $p_1$ and $p_2$ for the first and second periods, respectively. No binding commitments about future prices can be *ex ante* made. The product quality burdens on the marginal cost, denoted by $c(q)$. It is more expensive to produce one unit of higher quality, $c'(q) > 0$, and the marginal cost increases with quality at a faster rate when the quality is higher, $c''(q) > 0$. For expositional simplicity, we apply a convex quadratic form for the cost function, though our main results are robust to the general form. Specifically, assume that $c(q) = \gamma q^2 / 2$, where $\gamma$ is a positive scalar. The fixed cost (including R&D spending, marketing expenditure, etc.) is assumed away, as it is considered to be a sunk cost for the innovator.

To maximize the present value of profits over the two period horizon, there are three possible pricing strategies for the innovator. If the innovator wants to tap the consumers in both types, it could either sell to both types in Period 1, which is referred to as *volume strategy*, or sell to one type at one time, which is referred to as *intertemporal pricing strategy*. Let $\delta$ be the innovator’s discount factor on future profits; $\delta \in [0,1]$. Rather than inducing the sales to the whole market, the innovator may adopt a *margin strategy* to tap type H consumers only. Consumers behave as price takers without any bargaining power in the market. Hence, the corresponding models for the innovator’s strategies are detailed below.

**Volume Strategy**

Under volume strategy, the innovator intends to sell to both types at the same time. In this case, its price has to be set low enough to ensure non-negative surplus for all consumers. Let $p_t$ be the price in Period $t$. The problem under this strategy is

**Problem 1**

\[
\max \quad \pi_{vl}(q, p_1) = p_1 - c(q) \\
\text{subject to} \quad V_i(q) \geq p_1 \quad \text{for} \quad i = H, L. \quad (participation)
\]

Constraint (2) includes the participation constraint for each type which ensures all consumers buy in the first period. Based on the constraints, in order to serve all consumers, the innovator should price at $p_1^*(q) = V_L(q)$. Substituting the optimal price into (1) and maximizing with respect to $q$ yields the optimal quality decision $q_{vl}^* = \theta / \gamma$, which results in profits.
\[ \pi_1^* = \frac{\theta}{2\gamma} \]  

**Intertemporal Pricing Strategy**

To tap both types, the innovator’s second option is selling to one type at one period. While the future profits are discounted, the best way for the innovator to achieve this is to serve type H with a higher price in Period 1 and then cut down the price in Period 2 to serve type L.

By adopting intertemporal pricing strategy, there would be only type L left in the market in Period 2. Although the price in the second period \( p_2^*(q) \) cannot be ex ante committed, the consumers would rationally expect in Period 1 that the innovator will extract the whole surplus from type L consumers by setting its optimal second period price at

\[ p_2^*(q) = V_L(q) \]  

as long as it can gain positive profits from doing so.

Based on the expected second period price in (4), consumers make their decisions about purchase timing in the first period. Taking consumers’ behavior into account, the problem for the innovator in Period 1 then becomes

**Problem 2**

\[
\text{max } \pi_{d}(q, p_1) = (p_1 - c(q))\alpha + \delta(p_2(q) - c(q))(1 - \alpha) \\
\text{subject to} \quad (4) \text{ and} \\
V_H(q) - p_1 \geq \delta_c (V_H(q) - p_2(q)), \quad \text{(intertemporal choice - high)} \tag{6} \\
V_L(q) - p_1 \leq \delta_c (V_L(q) - p_2(q)), \quad \text{(intertemporal choice - low)} \tag{7} \\
V_H(q) \geq p_1, \tag{8} \\
p_2(q) > c(q). \tag{9}
\]

With constraints (6) and (7), consumers in each type voluntarily choose the timing of purchase meant for them. The constraint (9) says that to ensure positive profits in the second period, \( p_2^*(q) \) has to be higher than the marginal production cost. In other words, only if (9) holds, type L buys at \( p_2^*(q) = p_2^*(q) = V_L(q) \) in the second period. But to ensure type H buy in the first period, the innovator has to make the intertemporal choice constraint (6) binding by pricing at
$p_1^*(q) = (1 - \delta) V_H(q) + \delta q p_2^*(q)$. In terms of the quality level, while restricted by the constraint (9), the optimal choice can be obtained as

$$q_{pd}^* = \begin{cases} \frac{\alpha(1-\delta) + \theta(\alpha\delta + \delta - \alpha\delta)}{\gamma(\alpha + \delta - \alpha\delta)} & \text{if } \theta > \theta_0 \\ \frac{2\theta}{\gamma} & \text{if } \theta \leq \theta_0 \end{cases}$$

where $\theta_0 = \frac{(1-\delta)\alpha}{2\alpha - \delta \alpha + \delta(1-\alpha)}$.

Note that when $\theta \leq \theta_0$, the constraint (9) is binding and the optimal quality decision equals to that which makes the profits from low-end market zero. This implies that in this case, it is no longer profitable for the innovator to serve type L consumers. However, if tapping the type H only is of the innovator’s best interest, the margin strategy by setting a high price in both periods as analyzed below would be preferable to the intertemporally price discrimination. Therefore, the intertemporal pricing strategy could be the optimal option if and only if $\theta > \theta_0$, and in this case, the innovator can earn profits from adopting this strategy

$$\pi_{pd}^* = \frac{[\alpha(1-\delta) + \theta(\alpha\delta + \delta - \alpha\delta)]^2}{2\gamma(\alpha + \delta - \alpha\delta)}.$$ 

**Margin Strategy**

Besides the above two strategies, the innovator may choose to target on the type H consumers only by adopting the margin strategy. This strategy allows the innovator to charge a high price and thus gain a high margin. However, the question is when would the sales happen? As mentioned above, consumers decide their purchase timing in response to the expected price dynamics. If consumers in type H predict that the innovator has an incentive to serve type L in the second period with a lower price after they purchase, following the similar logic in Moorthy and Png (1992), they would rather buy in the first period. As a result, to induce type H purchase in the first period, the innovator bears one more constraint which enables it to convince that selling to type L in the second period is not profitable; that is

$$p_2^*(q) \leq c(q) \quad (10)$$

where $p_2^*(q)$ is given in (4).

Now it is clear that under margin strategy, besides the price and quality decisions, the innovator also needs to determine the timing of sales to happen if consumers are strategic ($\delta > 0$). The problem under margin strategy face the innovator should be formulated as
Problem 3

\[
\max \pi_{mg}(t, q, p_t) = \delta^{t-1} (p_t - c(q)) \alpha
\]

subject to (4) and

\[
V_H(q) \geq p_t, \quad (12)
\]

\[
c(q) \geq (2 - t)p^*_2(q), \quad (13)
\]

\[
t \in \{1, 2\}. \quad (14)
\]

In Problem 3, constraint (12) ensures that the type H consumers buy and constraint (13) captures the innovator’s decision about when to let them buy. Apparently, as restricted by the constraint (13), the innovator cannot always sell to type H in Period 1 with quality that maximizes (11). Therefore, when the quality level results from the first order condition of (11) cannot satisfy the constraint (13), the innovator should either increase the quality to make this constraint binding or sell to type H in the second period. Since the innovator only taps on type H consumers, the constraint (12) must be binding and optimal price under margin strategy is \( p^*_2(q) = V_H(q) \).

Substituting \( p^*_2(q) \) into (11), the problem is to choose the quality level which is however associated with the timing of sales implied by constraint (13). Lemma 1 summarizes the optimal quality decision and resulting profits under margins strategy.

**Lemma 1** Under margin strategy, when \( \delta_c = 0 \), the optimal quality is \( q^*_mg = 1 / \gamma \) and the innovator’s resulting profits are \( \pi^*_mg = \alpha / 2\gamma \). However, when \( \delta_c > 0 \), the optimal choice of quality becomes

\[
q^*_mg = \begin{cases} 
\frac{2\theta}{\gamma} & \text{if } \theta \in [\theta^mg_1, \theta^mg_2] \\
\frac{1}{\gamma} & \text{otherwise}
\end{cases}
\]

and the resulting profits are

\[
\pi^*_mg = \begin{cases} 
\frac{\alpha}{2\gamma} & \text{if } \theta \leq \theta^mg_1 \\
\frac{2\theta\alpha(1-\theta)}{\gamma} & \text{if } \theta^mg_1 < \theta \leq \theta^mg_2 \\
\frac{\delta}{2\gamma} & \text{if } \theta^mg_2 < \theta \leq 1
\end{cases}
\]

where \( \theta^mg_1 = \frac{1}{2} \), \( \theta^mg_2 = \frac{1 + \sqrt{1 - \delta}}{2} \).
We illustrate Lemma 1 in Figure 1. From the figure, it is straightforward to see that the innovator’s profits under margin strategy are always lower if consumers are forward-looking than if consumers are myopic. As shown in Lemma 1, when consumers are myopic, i.e. \( \delta_c = 0 \), since the purchase timing is not an issue. It implies that the innovator can always sell to type H in the first period and extract the entire surplus from them. In fact, that is exactly what the innovator can obtain from tapping type H if it is possible to credibly pre-commit to future prices. As expected, the innovator’s profits are lower when consumers are forward-looking rather than myopic since it lacks of a credible commitment mechanism. This predicament refers to the time-inconsistence problem mentioned in many existing literatures (e.g. Coase, 1972; Stocky, 1981; Bulow, 1982).

**Figure 1 Innovator’s Optimal Profits Strategy under Margin Strategy**

Figure 1 also illustrates an interesting outcome in the innovator’s optimal profits when consumers are forward-looking, i.e. \( \delta_c > 0 \). In this case, the optimal profits under margin strategy start to decrease with the relative marginal valuation \( \theta \) when \( \theta \) crosses a threshold \( \theta_{mg}^{1} \). The reason for this decrease is that while the difference between two types is not large enough, the type L’s willingness to pay for a product with certain quality is closer to the type H which makes targeting on type H in the first period is not that easy. In this case, to enlarge the discrepancy in consumers’ product valuation and avoid the low segment purchasing, the innovator has to invest in quality improvement until consumers believe that it cannot afford to serve the low segment anymore. Formally, the innovator increases its quality level from \( \gamma \) up to \( 2 \theta / \gamma \) when \( \theta \in [\theta_{mg}^{1}, \theta_{mg}^{2}] \).

**Proposition 1** In a monopolistic case, if the margin strategy is adopted and \( \delta_c > 0 \), there always exists a nonempty interval for the relative marginal valuation, \( [\theta_{mg}^{1}, \theta_{mg}^{2}] \), wherein the innovator strategically increases its quality level in order to make a credible commitment to a high future price.
This overprovision of quality works as a credible commitment (a similar mechanism is mentioned in Choi (1994)) but incurs an inefficient cost in production that decreases the innovator’s profits. As the value of $\theta$ increases, the innovator distorts its quality level even more to push type H purchase early and then, its profits decrease more. While the value of $\theta$ increases farther, especially when exceed $\theta_2^{myo}$, it is no longer profitable to distort its quality to serve type H in the first period. Therefore, with a sufficiently high difference between consumers, the innovator will just let type H buy in the second period.

Using the results obtained above, we compare the optimal profits under each strategy and characterize the innovator’s optimal pricing strategy as summarized in Table 1.

<table>
<thead>
<tr>
<th>Optimal Pricing Strategy</th>
<th>$\hat{\theta}$, $\hat{\delta}_c^1$, and $\hat{\delta}_c^2$ are specified in the Appendix.</th>
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<tbody>
<tr>
<td>$\theta &gt; \hat{\theta}$</td>
<td>$\delta_c &gt; \delta_c^1$ Volume Strategy</td>
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<td>$\delta_c \leq \delta_c^1$ Intertemporal Pricing Strategy</td>
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<tr>
<td>$\theta \leq \hat{\theta}$</td>
<td>$\delta_c &gt; \delta_c^2$ Margin Strategy</td>
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<tr>
<td></td>
<td>$\delta_c \leq \delta_c^2$ Intertemporal Pricing Strategy</td>
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From Table 1, it can be easily verified that the margin strategy is preferable to the volume strategy if there is a significant difference between the two types’ marginal valuation, i.e. $\theta < \hat{\theta}$. This result is quite intuitive. While setting its optimal price at the type L’s valuation, the volume strategy results in profits that are increasing in the type L’s valuation to the product. However, as Lemma 1 demonstrates, the innovator’s profits under margin strategy is non-increasing in $\theta$. Consequently, in the market with low heterogeneity, the innovator is more inclined to pick the volume strategy.

Table 1 also shows that there always exists a threshold such that when the consumers’ patience level $\delta_c$ is higher than the threshold, it is not preferable to adopt the intertemporal pricing strategy. This confirms a conjecture that intertemporal pricing strategy is only possible when the consumers are relatively impatient or myopic that they only reactive to current prices. In addition, the monopolistic innovator’s temporal prices are always lower with rational consumers than with myopic consumers (Besanko & Winston, 1990; Moorthy, 1988). Therefore, when consumers are forward-looking, overlooking consumers’ rational expectations may have a detrimental effect on the innovator’s profitability under intertemporal pricing strategy.

**COMPETITION MODEL**

What happens if the innovator faces a potential imitative entry, especially when the consumers are strategic instead of myopic? To address this question, we plan to conduct a more rigorous
and extensive study by extending the two-period dynamic model to a competitive setting where
the innovator possesses a monopoly power in the first period and the imitator, may enter the in
the second period.

The sequence of decisions is specified as follows. The innovator chooses the product quality in
the first period and dynamically sets the per-period price at the beginning of each period.
Observing the innovator’s decisions, the imitator, if decides to enter in the second period, clones
the innovation invented by the innovator and determines the quality level \( q_s \) of its imitative
product. The imitator also reacts to the innovator’s product and pricing strategies by setting a
competitive price \( p_s \) in the second period. Note that the sequential choice of decisions signifies
the innovator’s role as a product leader in the market.

In this section, we study the imitator’s problem first and then the innovator’s decisions taking the
potential imitative entry into account.

The Imitator’s Problem

While the imitative product bears a similar feature to the original one, it may not be as well
received by the consumers (Carpenter & Nakamoto, 1990). Normally, consumers are more
willingness to pay for a price premium for brand-name product over the not famous imitative one.
In other words, the consumers’ perceived utility of the imitative product is unlikely to be higher
than that of the innovative one. To accommodate this crucial influencing factor on consumer
choice, we define \( \beta_i, 0 \leq \beta_i \leq 1 \), as the relative utility of the imitative product to the innovative
product for the customers in type \( i, i \in \{H, L\} \). Denote \( V^i_i(q_s) \) to be the customers’ perceived
utility of the imitative product with quality \( q_s \). It follows that \( V^i_i(q_s) = \beta_i V^i_i(q_s) \), where the
function \( V(\cdot) \) is defined in Problem 1. The relative utility \( \beta_i \) can be viewed as the consumers’
acceptance of the imitative product. Since the imitative product without a brand name is
relatively less acceptable by the high-end than by the low-end consumers (Grossman and Shapiro
1988b), it is assumed that \( \beta_H < \beta_L \). Without loss of generality, we first set \( \beta_H = 0 \) and use \( \beta \)
to represent \( \beta_L \).

At the outset of the second period, after learning the innovator’s decisions on quality \( q \) and
prices \( p = (p_1, p_2) \), the problem for the imitator can be modeled as

\[
\max_{p_s, q_s} \pi_s(q_s, p_s \mid q, p) = (p_s - c_s(q_s))(1 - \alpha) - \lambda F
\]  

subject to \( V^s_L(q) - p_2 \leq V^s_L(q_s) - p_s, \) 

\( V^s_L(q) \geq p_s. \)

\[ (15) \]

\[ (16) \]

\[ (17) \]
where \( c_s(q_s) = \gamma \frac{q_s^2}{2} \) is the marginal cost for the imitative product with quality level \( q_s \). The difference between \( \gamma \) and \( \gamma_s \) captures the difference in cost of producing one unit innovative and imitative product.

The right hand side of constraint (16) is a consumer’s surplus if he purchases the imitative product and thereby, this constraint ensures that the type L customers prefer the imitative to the innovative product. To make sure that the imitative product will be purchased, the participation constraint in (17) must be satisfied. Solving the above problem, we derive the imitator’s best response to the innovator, denoted as \( (p_s^*, q_s^*) = \arg \max_{(q_s, p_s) \in \Omega} \pi_s(q_s, p_s \mid q, p) \), where \( \Omega \) is the feasible set of \((q_s, p_s)\) which satisfies (16) and (17).

**Lemma 2** Given the innovator’s decisions, the imitator’s optimal price and quality decisions are

\[
(p_s^*, q_s^*) = \begin{cases} 
(V_L^s(q_s) - V_L(q) + p_2, \frac{\beta \theta}{\gamma_s}) & \text{if } V_L(q) - p_2 > 0 \\
(V_L^s(q_s), \frac{\beta \theta}{\gamma_s}) & \text{otherwise}
\end{cases}
\]

The resulting profits are

\[
\pi_s^*(q_s, p_s \mid q, p) = \begin{cases} 
(1 - \alpha)\frac{\beta^2 \theta^2}{2 \gamma_s} - V_L(q) + p_2 & \text{if } V_L(q) - p_2 > 0 \\
(1 - \alpha)\frac{\beta^2 \theta^2}{2 \gamma_s} & \text{otherwise}
\end{cases}
\]

Clearly, the imitator will stay out of the market if \( \pi_s(p_s^*, q_s^* \mid q, p) \leq 0 \). If it decides to entry, the imitator’s profits are mainly affected by the consumers’ attitude towards imitative product as well as its imitation ability in terms of the imitation cost. In particular, the imitator gains more benefits from entry if the consumers’ acceptance level of imitative product in the market is high or if the producing cost of imitation is low, i.e. \( \partial \pi_s^*(q_s, p_s \mid q, p) / \partial \beta > 0 \) and \( \partial \pi_s^*(p_s, q_s^* \mid q, p) / \partial \gamma_s < 0 \). From Lemma 2, it is worth noting that when the innovator’s second period price \( p_2 \) is higher than the type L’s valuation, the imitator is able to extract the entire surplus from type L and have the maximum profits that it can gain from entry. To simplify the future analysis, we introduce an intermediate parameter \( \chi = \beta^2 / 2 \gamma_s \) to reflect the consumers’ surplus from purchasing the imitative product and thus the attractiveness of potential market for an imitative entrant in this case.
The Innovator’s Strategies towards Imitative Entry

As the imitator’s entry decision indicates, the innovator who anticipates the threat of imitative entry in the second period, can strategically change the product quality and/or the pricing plan to either deter or tolerate the imitation.

To deter the imitative entry, there are two possible approaches for the innovator. The first one is to exhaust the market with the *volume strategy* by aggressively taping both high-end and low-end segments in the first period, leaving no incentive for the imitator to enter in the second period. The decisions in this enter deterrence approach can be obtained by solving the Problem 1 with an additional constraint

\[
V_i(q) - p_1 \geq \delta_c (V_i^*(q_s^*) - p_s^*) \quad \text{for } i = H, L \quad \text{(entry deterrence)} \quad (18)
\]

The constraints in (18), together with constraints in Problem 1, ensure that all customers buy the innovative product in the first period.

The other approach to deter the imitative entry is to create an effective competitive entry barrier in the second period with the *intertemporal pricing strategy*. With this strategy, the imitative entry is deterred by a low price the innovator set in the second period. Therefore, the following entry deterrence must be satisfied to ensure that the low-end customers derive a higher surplus from the innovative than from the imitative product:

\[
V_L(q) - p_2 \geq V_L^*(q_s^*) - p_s^*. \quad \text{(entry deterrence)} \quad (19)
\]

Let \( \hat{p}_2(q) \) be the price level in Period 2 such that constraint (19) binds. The consumers’ anticipation on the second period price in this case turns out to be

\[
p_s^c(q) = \begin{cases} 
V_L(q) & \text{if } \pi_s(p_s^*, q_s^* | q, p) < 0 \\
\hat{p}_2(q) & \text{otherwise}
\end{cases} \quad (20)
\]

Note that this approach is profitable only when the marginal profit in Period 2 is positive. The corresponding model with the intertemporal pricing strategy can be specified by Problem 2 in which the expected second period price should be changed from (4) to (20).

Instead of deterring the imitative entry in a hostile manner, the innovator can choose to tolerate it with the *margin strategy* by tapping only the type H and surrender the type L to the imitator. Recall the innovator’s Problem 3 under *margin strategy* in the benchmark case. The purchase time of type H depends on its belief about the innovator’s incentive to cut down the price and serve type L. In the presence of potential imitative entry, the type H’s expectation on the second period is given in (20). Therefore, the Problem 3 should be modified by replacing (4) with (20). After solving this problem, the innovator would obtain its optimal quality, prices and the timing of sales accordingly.
So far we describe the innovator’s problem under each strategy in the presence of imitative entry. Solving the revised Problem 1 through Problem 3 based on the rationale of consumers’ intertemporal choice (assume that $c > 0$) the optimal quality, prices, and the corresponding profits with respect to each of the three strategies identified above can be obtained, which are summarized in Table 2.

Table 2 Summary of the Innovator’s Decisions in the Presence of Imitation

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Volume Strategy</th>
<th>Intertemporal Pricing Strategy</th>
<th>Margin Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>$q_{vlq}$</td>
<td>$q_{pd}$</td>
<td>$q_{mg}$</td>
</tr>
<tr>
<td>Prices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period 1</td>
<td>$p_1^*$</td>
<td>$V_L(q_{vlq}) - \delta \theta^2 \chi$</td>
<td>$V_H(q_{mg})$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$(1 - \delta)V_H(q_{pd}) + \delta (V_L(q_{pd}) - \theta_2 \chi)$</td>
<td></td>
</tr>
<tr>
<td>Period 2</td>
<td>$p_2^*$</td>
<td>$V_L(q_{vlq}) - \theta_2 \chi$</td>
<td>$V_H(q_{mg})$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_L(q_{pd}) - \theta_2 \chi$</td>
<td></td>
</tr>
<tr>
<td>Profits</td>
<td>$\tilde{\pi}<em>{vlq} = \pi</em>{vlq} - \delta \theta^2 \chi$</td>
<td>$\pi_{pd} = \pi_{pd} - (\alpha \delta_2 + (1 - \alpha)\delta) \theta^2 \chi$</td>
<td>$\tilde{\pi}_{mg} = \frac{\alpha}{2\gamma}$ if $\theta &lt; \tilde{\theta}_1$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\pi_{pd} = \pi_{pd} - (\alpha \delta_2 + (1 - \alpha)\delta) \theta^2 \chi$</td>
<td>$\tilde{\pi}_{mg} = \frac{\alpha}{2\gamma}$ if $\tilde{\theta}_1 &lt; \theta \leq \tilde{\theta}_2$</td>
</tr>
</tbody>
</table>

where $\tilde{\theta}_1$ and $\tilde{\theta}_2$ are specified in the Appendix.

Table 2 shows that if the innovator decides to deter entry, its profits decrease while the consumers’ surplus from purchasing the imitative product $\chi$ increases. From the two entry deterrence constraints (18) and (19), one may see that if the consumers expect that they can gain more surplus from purchasing the imitative product, i.e. $V_L(q_{vlq}) - p_1^*$, a lower price in either Period 1 or Period 2 is required for the innovator to deter entry successfully and win the low-end market. However, if the innovator tolerates the imitative product, an increase in the consumers’ surplus from purchasing the imitative product may enhance the innovator’s profits. The reason behind is that when the imitative product is more attractive to type $L$ consumers, the type $H$ consumers’ expected second period price of the innovative product $\tilde{p}_2^*$ in (20) decreases, which somehow relaxes the innovator’s constraint (13) in Problem 3. To this end, the innovator’s optimal decision on whether deterring the imitative entry or not depends on the consumers’ surplus they can obtain from purchasing the imitative product. Hence, we can obtain the innovator’s optimal strategy towards the imitative entry in the following proposition.

**Proposition 2 (Innovator’s Optimal Strategy Towards The Imitative Entry)** The innovator should tolerate the imitative entry if its optimal choice without imitation is margin strategy or if the imitation is attractive enough ($\chi \geq \bar{\chi}$); otherwise, it should deter the imitative entry.
Clearly, a substantial cost advantage of imitation results in a high consumer surplus since it allows the imitator to charge a much lower price for its product. On the other hand, a consumer gets more benefits from buying the imitative product if he values it closer to the innovative product, i.e. $\beta$ is large. van Horen & Pieters (2012) finds that for different type of imitative product, the consumers’ attitude varies. Specifically, consumer evaluation of the imitative product is higher if the product imitates the underlying meaning or theme of the brand-name product than if it just mimics the perceptual features. Proposition 2 provides an implication for the threatened innovator that before ambiguously deterring the imitative entry, it should carefully examine how consumers feel about the imitative product as well as how much the imitator can save from imitation instead of innovation. While the imitative rivalry is extremely competitive that fighting with it face to face may leads to a huge loss, turning a blind eye on it might be a wiser choice for the innovator. In this sense, there is another way of interpreting Proposition 2 that the innovator’s choice between deterring or accommodating entry depends on the intensity of competition brought by the imitative product.

Although the result in Proposition 2 is obtained by considering only one imitative entry, it can be conjectured that if there is a large number of imitations which further tensions the competition between the innovator and imitators, the innovator would be more likely to tolerate the imitative products and concentrate on the high valuation consumers only. Given the innovator’s best reaction towards the imitation specified above, the next question comes in mind is that how would the innovator’s optimal decisions and profitability changes compared to the case without the threat by imitative entry.

**Impacts of Imitative Entry**

Table 2 reveals that the innovator’s profits from enter deterrence either by volume strategy or intertemporal pricing strategy is lower than the profits it can obtains in the absence of imitative entry ($\pi_{e1}^* \leq \pi_{ul}^*$ and $\pi_{pd}^* \leq \pi_{pd}^*$). This loss in the innovator’s profits caused by the threat of imitative product becomes larger when the potential market for the imitator is more profitable. But what if the innovator decides to tolerate the imitative entry? From Table 2, it is straightforward to see that the innovator’s optimal profits under margin strategy follow a similar trend with that in Figure 1. The only distinction is that the nonempty interval that the optimal profits decrease in becomes $[\hat{\theta}_1, \hat{\theta}_2]$. Given the definition of $\hat{\theta}_1$ and $\hat{\theta}_2$ in the Appendix, it can be proved that $\vartheta_{mg}^* \leq \hat{\theta}_1$ and $\vartheta_{mg}^* \leq \hat{\theta}_2$. Because of this, the continuity of innovator’s optimal profits with respect to $\theta$ is able to verify that the innovator is not worse off under margin strategy in the presence of imitative entry, i.e. $\pi_{mg}^* \geq \pi_{mg}^*$. Especially, when $\theta$ falls in the region $[\vartheta_{mg}^*, \hat{\theta}_2]$, the innovator’s profits are increased by the imitative entry. This finding is highlighted in the following proposition.

**Proposition 3 (Benefit from Imitative Entry)** In the presence of imitative entry, when it is optimal for the innovator to tolerate it, the innovator may gain more profits than it can gain with no imitation. Formally, there exist thresholds $\hat{\theta}$ and $\hat{\delta}_c$ that when $\delta_c > \hat{\delta}_c$, the innovator’s profits are increased by the imitative entry if $\hat{\theta}_1 \leq \theta \leq \hat{\theta}$ and remain the same if $\theta < \hat{\theta}_1$. 

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How does the imitative product help to increase the innovator’s profits? Conner (1995) answers the question in the context of network externality where the imitative product can be seen as a complementary product that adds the user base for the innovator. Whereas, we assume away the network effect in the paper and try to explain this argument by emphasizing the role of rational consumers’ expectations.

As mentioned earlier, if the innovator adopts the margin strategy to tap type H only in Period 1, its quality decision is related to whether consumers’ anticipated second period price is above the marginal cost. In the anticipation of the potential imitative entrant, type H consumers would think that the competition brought in by the imitative product will decrease the innovator’s profitability from the low-end market and thereby the price of innovative product will be less likely to be cut down in the second period. Thus, waiting makes no sense for them. While type H consumers have a lower expectation on second period price, it requires less effort for the innovator on quality distortion to achieve its commitment ability. In other words, we can say that the threat of imitative entry works as a credible commitment mechanism that helps in remedying the innovator’s time-inconsistency problem and enhancing its profits.

Proposition 3 illustrates that the presence of imitative entry makes the margin strategy more preferable to the other two pricing strategies compared with the benchmark case where no imitation is considered. However, how would the imitative product influence the innovator’s choice between the volume strategy and intertemporal pricing strategy?

Proposition 4 Compared to the case with no imitation, the intertemporal pricing strategy is more preferable to the volume strategy in the presence of imitative entry if the firm is not as patient as consumers, i.e. \( \delta < \delta^c \) and vice versa.

Recall that in the benchmark case, volume strategy is not affected by the consumers’ forward looking behavior. However, when there would be a later imitative entrant, the innovator has to compensate the consumers’ loss from not purchasing the imitative product in the second period which could be higher if consumers value their future consumptions even more. Therefore, when consumers are patient enough, the volume strategy is not that appealing to the innovator. The result in Proposition 4 also indicates the critical role of relative patience of the firm versus consumers played in the innovator’s choice of entry deterrence strategy.

Besides the influence of imitative entry on the innovator, we are also interested in it on the consumers as well as the whole society. In Table 3, we summarize the consumer surplus for each type and the total social welfare, which is the sum of consumer surplus, the innovator’s and imitator’s profits. The comparison of consumer surplus in the case with and without imitation shows that consumers are not worse-off when there is a later imitative entry and especially, if the innovator can deter the imitative entry successfully, each of them can obtain an increase of \( \theta^2X \) in the surplus. Furthermore, we find that the imitative entry enhances the social welfare under margin strategy and that under intertemporal pricing strategy if \( \delta^c > \delta \). Therefore, we obtain the following result.
Table 3 Summary of Consumer Surplus and Social Welfare

<table>
<thead>
<tr>
<th></th>
<th>With no Imitation</th>
<th>In the Presence of Imitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consumer Surplus</td>
<td>Social Welfare</td>
</tr>
<tr>
<td></td>
<td>Type H</td>
<td>Type L</td>
</tr>
<tr>
<td></td>
<td>Volume Strategy</td>
<td></td>
</tr>
<tr>
<td>V_H(q_H) - V_L(q_L)</td>
<td>0</td>
<td>α(V_H(q_H) - V_L(q_L)) + π*</td>
</tr>
<tr>
<td></td>
<td>π*</td>
<td></td>
</tr>
<tr>
<td>Intertemporal Pricing</td>
<td>0</td>
<td>αδ*(V_H(q_H) - V_L(q_L)) + π*</td>
</tr>
<tr>
<td>Strategy</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Margin Strategy</td>
<td>0</td>
<td>π*</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Proposition 5** The imitative product that follows an innovative product and enters the market after a certain period of time may be socially desirable.

**CONCLUDING REMARKS**

The impact of imitative product has received great attention in the marketing and economic literatures. Most of the studies are conducted in a static framework. This paper investigates the innovator possible strategic reaction to the imitative product and its impact on the innovator’s profitability in a two-period model that highlights the role of strategic consumers. Our analysis shows that it is not always best for the innovator to deter the imitative entry, especially when the potential market is sufficiently appealing to the imitator to enter. And, unexpectedly, under some circumstance, if the innovator tolerates the imitative entry, it may benefit from the threat by the imitative entry. The reason behind is that if there is no imitator, it is difficult for the innovator who is incapable to commit to future price to tap high-end consumers only in the first period, unless distorting its quality to an inefficient level. While the emergence of imitative entry helps in convincing the type H consumers that it is no longer attractive for the innovator to sell to the low-end market, the innovator does not need suffer from quality distortion and as a result its profits increase. Our finding provides an explanation to the pervasive existence of imitative product and also suggests that when consumers are sufficiently patient and heterogeneous, rather than engaging into the sever competition with imitative product, the innovator should consider accommodate it which however may result in a higher profits than there is no imitation. Moreover, this result contributes to the literatures on time-inconsistency problem by showing that strategically allowing later competitive entrant can be seen as an alternative mechanism to alleviate the incumbent’s time-inconsistency problem caused by the strategic consumer behavior. One implication from the result indicates that there always exist some conditions under which the innovator could benefits from the imitative entry. Therefore, before taking any actions against the imitative product, the innovator needs to carefully examine the consumers’ attitude towards imitation, marginal cost between the innovative and imitative product, relative size of high and low valuation consumers in the market as well as their heterogeneity. Otherwise, an inappropriate loss may occur.
Facing the imitative entry, marketing managers often consider about licensing its product or extending its product line to hinder the competitive entry. This paper shows that charging a positive licensing fee to the imitator does not always lead to an increase in the innovator’s profits. It is because that when the imitator has to pay the licensing fee, the competitiveness of imitative product in the low-end market is reduced. So if the innovator claims a positive licensing fee, consumers would believe that the possibility that the innovator intends to serve the low-end market in the second period increases, which means that it may require the innovator to distort its quality more than the case that without licensing. Besides, we extend our basic model to discuss whether the innovator should introduce a fighting low-end product to seize the market if there is a potential imitative entry. Consistent with the results in our core model, we find that even though introducing a fighting low-end product is costless, the innovator should not do so when the marginal cost of imitative product is sufficiently low.

To ensure that the equilibrium investigations based on the models proposed above are inherently tractable and are with promising potentials to yield impactful outcomes, we solve a very basic case which focuses only on the price competition by isolating other possible decisions. There are several potential interesting issues that can be considered in the future work. For example, this work does not discuss impact of imitation on the innovator’s choice of innovation level. To examine this issue, it is essential to incorporate the R&D expenditure on innovation and imitation. Mansfield et al. (1981) shows that the imitation cost is proportional to the innovation cost and also influenced by the time spent on imitation. Therefore, a higher innovation level can increase the imitation cost, reduce the degree of imitation or slow down the whole imitation process. It would somehow deter the imitative entry or lessen the negative effect of it on the innovator. However, if the innovator prefers to tap the type H only, a higher innovation level that diminishes the imitative product’s competitiveness also weakens the power of imitative entry as a credible commitment. To this end, it is not clear but interesting to know how the innovator alters its innovation level facing a potential imitative entry. Another direction for further research is to investigate the cooperation between the innovator and imitator. Our result shows that in some cases beating the imitative entry is not as good as partnering with it. But the task of cooperation is quite complex in the market. It allows the incumbent to “forcing” the imitator lower price to soften competition and avoids the brand image infringement from imitator. On the other hand, the implementation of cooperation means the original firm should reveal more advanced technology and private information to the exclusive firm which is quite risky. That’s why the decision of whether cooperate with the imitator is often gripped by the brand-name managers. Thus the investigation of the cooperation issue is of great importance to the innovator. Moreover, while taking the supply chain issue into consideration, another particularly interesting problem raised will be to examine the contract design between the brand-name company and its contracted manufacturer.

REFERENCES


