Marketing Innovation*

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Final Version

Abstract: This paper provides an economic analysis of marketing innovation. A dynamic duopoly model is developed to study two forms of marketing innovation: $\gamma$, which allows a firm to acquire consumer information effectively; and $\sigma$, which reduces consumer transaction costs. The incentives and effects of marketing innovation differ markedly from those of product or process innovations. While $\gamma$ benefits the innovating firm, it hurts some consumers; and, while $\sigma$ benefits all consumers, it may or may not benefit the innovating firm. Increased competition intensity reduces the value of $\gamma$ but increases the value of $\sigma$. The private incentive is too high for $\gamma$ but too low for $\sigma$.

Keywords: marketing innovation, consumer information, transaction costs

JEL Classification Number: L1, M3

*I am indebted to a referee and a coeditor for their detailed and thoughtful comments that substantially improved the paper. I also thank Mark Armstrong, Gary Biglaiser, Joshua Gans, Brad Graham, Rune Stenbacka, participants of the Seminar on "Competition Strategies and Customer Relations" at the Helsinki Center of Economic Research, the 2004 Summer IO Workshop at Peking University, and seminar participants at Boston University, Michigan State University, University of Colorado at Boulder, and University of Colorado in Denver for helpful comments and discussions. Financial support of a Faculty Fellowship from the University of Colorado at Boulder is gratefully acknowledged.
1. Introduction

In a market economy, in addition to innovations in products and production processes, there are also innovations in the marketing of products. The development of new marketing tools and methods plays an important role in the evolution of industries. In recent years, for instance, new ways of gathering consumer information through innovative marketing programs and technologies have enabled firms to reach consumers more effectively and to use pricing strategies that were previously not feasible; new trading formats and techniques, such as online stores and Amazon.com’s “one-click” online ordering process, have expanded the market for many firms and potentially reduced consumer transactions costs. However, despite its obvious importance, and unlike product or process innovation, marketing innovation has received little attention in the economics literature. The purpose of this paper is to make a contribution to the economic analysis of marketing innovation.

I consider a dynamic duopoly where every instantaneous game is the familiar Hotelling model (Hotelling, 1929) before innovation and where at time zero a given firm can introduce a marketing innovation, possibly with some fixed (investment) cost $k$. The other firm lacks the ability to innovate, but can imitate with a delay of time $T$. Following the pioneering work of Arrow (1962), this formulation allows us to study the value (the incentive) of innovation to a firm who is the only one capable of innovating, recognizing that a marketing innovation can often be imitated by other firms with a delay. Since marketing innovation has many forms that differ in nature, my modeling strategy is to focus on two commonly observed forms of marketing innovation, $\gamma$ and $\sigma$, where $\gamma$ is a new marketing program or technology that allows a firm to acquire consumer information (target consumers) more effectively and to charge individualized prices, and $\sigma$ is a new trading method that reduces consumer transaction costs. I use this model to address the following economic questions: What are the incentives and effects of marketing innovation? How are these incentives affected by the possible imitation from the rivals? How does competition affect these incentives? And, how do the private and social incentives differ? My analysis offers interesting insights on these issues.
First, for marketing innovation $\gamma$, while it benefits the innovating firm (and thus there is incentive for innovation if $k$ is small and $T$ is large), it actually hurts some consumers; and for marketing innovation $\sigma$, while it benefits all consumers, it may not benefit the innovating firm due to the strategic response of the rival (and thus a firm may have no incentive to introduce $\sigma$ even if $k = 0$ and imitation is not possible). These are in sharp contrast to the effects and incentives of a product (or process) innovation, where the innovation tends to benefit both the innovating firm and the consumers due to increases in the total surplus from the innovation\(^1\).

Second, the imitation of a marketing innovation by a rival harms the innovating firm, same as for a product or process innovation; but, unlike a product or process innovation, the industry profit after both firms possess $\gamma$ (or $\sigma$) is lower than the industry profit before innovation. Thus, compared to a product or process innovation, imitation tends to have a more negative impact on the incentives for marketing innovation. Interestingly, sometimes a firm will even find it not profitable to imitate $\sigma$, which leads to a non-monotonic relationship between a firm’s innovation incentive and the reduction in transaction costs through $\sigma$. Moreover, while increasing $T$ (i.e., delaying imitation) increase the incentive for $\gamma$, it may or may not increase the incentive for $\sigma$.

Third, the effects of competition on the incentive for marketing innovation depend importantly on the nature of innovation. In particular, an increase in competition intensity reduces the innovation incentive for $\gamma$ but increases the incentive for $\sigma$.

Finally, compared to the social optimum, the private incentive is too high for $\gamma$ but too low for $\sigma$. The increased ability for the innovating firm to gather consumer information through $\gamma$ causes inefficient output diversion that is privately beneficial but socially wasteful. On the other hand, the reduction in consumer transaction costs through $\sigma$ intensifies competition for the innovating firm, creating a private (but not social) cost.

In recent years, there has been significant interest in whether business method innovations should receive patent protections (e.g., Gallini, 2002; and Hall, 2003). We may consider marketing innovation as part of the business method innovations, which also include financial innovation.\(^2\) By providing a framework to understand the effects and incentives of
marketing innovation and of its imitation, and by further comparing the private and social incentives for marketing innovation, the present paper sheds light on this policy debate. Patent protection will effectively increase $T$ (or delay imitation), which increases the incentive for $\gamma$ but may or may not increase the incentive for $\sigma$. Since the private incentive for $\gamma$ is too high while that for $\sigma$ is too low, our analysis suggests that patent protection would not be desirable for $\gamma$ and would only sometimes have a desirable effect for $\sigma$.

The rest of the paper is organized as follows. Section 2 sets up the basic model. Section 3 studies the marketing innovation to acquire consumer information. I start by providing two examples of $\gamma$, and then derive the value of $\gamma$ to the innovating firm and discuss its properties. Section 4 conducts the parallel analysis for the marketing innovation to reduce consumer transaction costs, $\sigma$, again starting with motivating examples of $\sigma$. Section 5 compares the private and social incentives for marketing innovation. Section 6 concludes. Proofs are gathered in an appendix.

2. The Basic Model

There is a continuum of consumers of measure 1 uniformly distributed on a line of unit length. Firms 1 and 2 are located respectively at the left and right ends of the line, each with unit production cost $c \geq 0$. Time is continuous. At every instant, each consumer desires at most one unit of the product with valuation $V$, and a consumer located at $x \in [0, 1]$ incurs shopping (transportation) costs $\tau x$ and $\tau (1 - x)$ to purchase from firms 1 and 2, respectively, where $\tau$ is the coefficient of shopping cost (or unit transportation cost). We assume $c + \frac{3}{2} \tau < V$ to ensure purchases by all consumers in equilibrium.

Suppose that, at time (normalized to) 0, one of the firms, say firm 1, has an opportunity to introduce a marketing innovation, denoted as $\phi$, with cost $k \geq 0$. The new marketing technology $\phi$, if introduced, can also be imitated by firm 2 with time lag $T > 0$ (for a cost normalized to zero). Firm 2 is otherwise not able to have the new marketing technology. We shall take $T$ as exogenously given and use it to examine the possible effects of alternative systems of intellectual property rights protection for marketing innovation.
Firms play a simultaneous price-setting game at every instant, where the price strategies are Markov—they depend only on the states of possible marketing innovation, as well as on consumers’ locations if such information is available. The set of possible states of innovation is \{(0, 0), (0, \phi), (\phi, 0), (\phi, \phi)\}, including the state of \phi by neither firm, of \phi by firm 1 alone, and of \phi by both firms. Notice that this rules out strategies that depend explicitly on the histories of prices. Assume that the discount rate for each firm is \(r\), each firm maximizes its discounted sum of profits, and it introduces (imitates) a marketing innovation if and only if the benefit is at least weakly positive. Each firm’s strategy in the game specifies its prices in every instantaneous game as well as its decision to introduce or imitate \phi. We analyze the value of innovation in the subgame perfect equilibrium of this game.

As a starting point, we state the equilibrium prices and profits for both firms where \phi is not introduced, or where the state is \((0, 0)\). The usual Hotelling analysis tells us that the unique equilibrium price strategies for firms \(i = 1, 2\) are \(p_i (0, 0) = c + \tau\), and consumers’ purchases are equally divided between the two firms. Thus, the equilibrium instantaneous profits of the two firms in state \((0, 0)\) are:

\[
\pi_i (0, 0) = \frac{1}{2} \tau. \quad (1)
\]

3. Acquiring Consumer Information

In this section, we consider a particular type of marketing innovation, the development of a new marketing program and/or information technology that improves the effectiveness of consumer targeting. We denote this innovation by \(\gamma\) (i.e., \(\phi = \gamma\)). Specifically, with \(\gamma\) a firm is able to learn the locations of all consumers.\(^5\) For example, in recent years, retailers have introduced preferred-customer cards or loyalty cards. Each time the card is swiped at the point of sale, the retailer’s information system records the name of the shopper, the time of the transaction, and the content of the purchase. These cards, in combination with the new information system developed, enable retailers to target consumers with individualized promotions and, effectively, individualized prices. An industry analyst, Brian Woolf, describes the use of such a marketing program by the supermarket chain Dorothy Lane in the
following: “Club DLM enables Dorothy Lane to stop running item-price ads. Now, much of the $250,000 it used to spend each year on newspaper advertising is plowed into the card program. Price discounts go only to club members. Direct mail is customized, based on individual shopping habits.” (Shapiro and Varian, 1999, p. 41-42.)

As another example, γ could be the development of an internet store that uses consumer-tracking technologies such as clickstream tracking, online registration, and cookies. Selling on the internet with such technologies enables a firm to better understand each individual customer’s tastes and to offer individualized prices. For instance, “Virtual Vineyards tracks the clickstream of each user and can instantaneously make them special offers based on their behavior” (Shapiro and Varian, 1999, p. 42).

Consider first instantaneous games where only firm 1 implements γ. For these and these instantaneous games only, we assume that firm 2 acts as Stackelberg leader, which ensures a pure-strategy equilibrium will exist, as in Thisse and Vives (1988). At every instant, the two firms play a game where we denote firm 1’s equilibrium strategy by $p_1(x | \gamma, 0)$ and firm 2’s equilibrium strategy by $p_2(\gamma, 0)$. Then, the marginal consumer is determined by

$$c + \tau \hat{x} = p_2(\gamma, 0) + \tau (1 - \hat{x}),$$

Or $\hat{x} = \frac{p_2-c}{2\tau} + \frac{1}{2}$. Firm 1 sells to consumers of $x < \hat{x}$ with $p_1(x | \gamma, 0) = \max \{c, p_2(\gamma, 0) + \tau (1 - 2x)\}$, while firm 2 sells to consumers of $x > \hat{x}$ with profit $\pi_2 = (p_2 - c) \left(\frac{1}{2} - \frac{p_2-c}{2\tau}\right)$, where $p_2(\gamma, 0)$ satisfies the first-order condition:

$$\frac{1}{2} - \frac{p_2 - c}{2\tau} - \frac{p_2 - c}{2\tau} = 0,$$

or

$$p_2(\gamma, 0) = c + \frac{\tau}{2}. \quad (2)$$

Thus,

$$p_1(x | \gamma, 0) = \max \left\{c, c + \frac{3\tau}{2} - 2\tau x\right\}, \quad (3)$$

and $\hat{x} = \frac{3}{4} + \frac{1}{2} = \frac{3}{4}$.

We note that the equilibrium prices for the consumers with $x < \frac{1}{4}$ will be higher than $c + \tau$, or higher than their price before $\gamma$. We thus immediately have:
Remark 1. Some consumers are made worse off by \( \gamma \).

The equilibrium instantaneous profits of firms 1 and 2 in state \((\gamma, 0)\) are:

\[
\pi_1 (\gamma, 0) = \int_0^3 \left( c + \frac{3\tau}{2} - 2\tau x - c \right) dx = \frac{9}{16}\tau, \tag{4}
\]

\[
\pi_2 (\gamma, 0) = \left( c + \frac{\tau}{2} - c \right) \left( 1 - \frac{3}{4} \right) = \frac{1}{8}\tau. \tag{5}
\]

Consider next the possible instantaneous games where both firms have implemented the new information technology, or in state \((\gamma, \gamma)\). The equilibrium prices offered by firms 1 and 2 to the consumer at location \(x\) will be \(p_1 (x \mid \gamma, \gamma) = \max\{c, c + \tau (1 - 2x)\}\) and \(p_2 (x \mid \gamma, \gamma) = \max \{c, c + \tau (2x - 1)\}\), respectively, and each firm makes sales to the consumers on its own half of the line. The equilibrium instantaneous profits for firms 1 and 2 in state \((\gamma, \gamma)\) thus are:

\[
\pi_1 (\gamma, \gamma) = \pi_2 (\gamma, \gamma) = \int_0^{\frac{1}{2}} \tau (1 - 2x) dx = \frac{1}{4}\tau. \tag{6}
\]

**Proposition 1** Let \(V^\gamma (T)\) denote the (subgame perfect) equilibrium value of \(\gamma\) to firm 1, excluding \(k\). Then,

\[
V^\gamma (T) = \frac{1}{16\tau} \left( 1 - 5e^{-\tau T} \right), \tag{7}
\]

and \(V^\gamma (T) \geq 0\) if and only if \(T \geq \frac{\ln 5}{\tau}\).

**Proof.** See the appendix.

Similar to the usual product or process innovation, \(\gamma\) is more likely to occur if the innovating cost \(k\) is lower and/or if imitation is more difficult (i.e., \(T\) is longer). In equilibrium, firm 1 will introduce \(\gamma\) if \(T\) is sufficiently large and \(k\) sufficiently small. However, here since \(V^\gamma (T) < 0\) when \(T < \frac{\ln 5}{\tau}\), \(\gamma\) will not occur under small \(T\) even when \(k = 0\), while a product or process innovation will likely be introduced if \(k = 0\). To see the reason for this possible difference, we can rewrite \(V^\gamma (T)\) as

\[
V^\gamma (T) = \frac{1}{\tau} \left[ \left( \pi_1 (\gamma, 0) - \pi_1 (0, 0) \right) + \left( \pi_1 (\gamma, \gamma) - \pi_1 (\gamma, 0) \right) e^{-\tau T} \right]. \tag{8}
\]

We can decompose the terms affecting \(V^\gamma (T)\) into two parts: \(\pi_1 (\gamma, 0) - \pi_1 (0, 0)\), the invention effect; and \(\pi_1 (\gamma, \gamma) - \pi_1 (\gamma, 0)\), the imitation effect. The imitation effect, which
occurs with the delay of time $T$, tends to be negative for the innovator, reflecting the fact that the innovator has a lower profit if the innovation is imitated by a rival. The sum of these two effects, without discounting the imitation effect, is

$$\delta = \left[ \pi_1(\gamma, 0) - \pi_1(0, 0) \right] + \left[ \pi_1(\gamma, \gamma) - \pi_1(\gamma, 0) \right]$$

$$= \pi_1(\gamma, \gamma) - \pi_1(0, 0) = \frac{1}{2} \left\{ \pi_1(\gamma, \gamma) + \pi_2(\gamma, \gamma) - [\pi_1(0, 0) + \pi_2(0, 0)] \right\}$$

$$= \frac{1}{2} \Delta,$$

where $\Delta$ is the change in the instantaneous industry profit if $\gamma$ were to be adopted simultaneously by all firms.

If $\gamma$ were a product or process innovation (a new product with higher demand or a new production process with lower production costs), one would generally expect $\Delta$ to be (weakly) positive. But here we have the opposite:

$$\pi_1(\gamma, \gamma) - \pi_1(0, 0) = \pi_2(\gamma, \gamma) - \pi_2(0, 0) = \frac{1}{4} \tau - \frac{1}{2} \tau = -\frac{1}{4} \tau < 0,$$

or $\delta < 0$ and $\Delta < 0$. This suggests that the simultaneous adoption of a marketing innovation by all firms can reduce industry profits. As a result, the possibility of imitation has a more negative impact on the incentive for marketing innovation, and $\gamma$ may not occur even when $k = 0$.

The innovation increases the innovating firm’s ability to extract consumer surplus, which benefits the innovating firm; but it also causes the competitor to respond with lower prices, which hurts the innovating firm. Before the imitation of $\gamma$ by the rival, the extracting-surplus effect dominates and thus the innovating firm benefits from $\gamma$. When $\gamma$ is adopted by both firms, however, the competitive-response effect becomes dominating, causing lower prices from both firms and thus lower profit for the industry.$^7$

Our analysis here is closely related to the literature on oligopoly price discrimination. Consumer targeting and price discrimination are often equilibrium strategies of competing firms, and such practices can often lead to lower profits for all firms involved, an outcome reminiscent of the Prisoner’s Dilemma game (e.g., Thisse and Vives, 1988; and Stole, 2003).$^8$

However, in our model, where the strategic interactions between competitors are viewed as
a dynamic process, the nature of the equilibrium changes dramatically. While the adoption of $\gamma$ by both firms leads to lower industry profits here, $\gamma$ can occur in equilibrium only if firm 1’s profit is higher from introducing it; the Prisoner’s Dilemma outcome disappears. Thus it can be profitable in equilibrium for a firm to introduce a new method of consumer targeting/price discrimination, even though it eventually lowers industry profits.\footnote{Thus it can be profitable in equilibrium for a firm to introduce a new method of consumer targeting/price discrimination, even though it eventually lowers industry profits.} Furthermore, when $T$ approaches zero, or when firm 2 can react very quickly to the introduction of $\gamma$ by firm 1, instead of a Prisoner’s Dilemma outcome, $\gamma$ does not occur in equilibrium.\footnote{Furthermore, when $T$ approaches zero, or when firm 2 can react very quickly to the introduction of $\gamma$ by firm 1, instead of a Prisoner’s Dilemma outcome, $\gamma$ does not occur in equilibrium.}

Since the equilibrium prices in all instantaneous games are increasing functions of $\tau$, we can consider $\tau$ as a measure of the competitiveness of the market, with a higher $\tau$ suggesting lower intensity in competition. An examination of equation (7) immediately reveals the following:

Remark 2 The value of $\gamma$ to the innovating firm is higher if $\tau$ is higher.

Thus, the value of $\gamma$ is higher when the market is less competitive. One way to see the intuition for this result is the following: When the market is less competitive, there are potentially higher profits that can be generated. This makes it more valuable to target consumers effectively using $\gamma$. As we shall see shortly, however, in general the relationship between the value of innovation and the competitiveness of the market is more complicated, depending on the nature of the marketing innovation.

4. Reducing Consumer Transaction Costs

We now consider a different type of marketing innovation, $\sigma$, the development of a new trading method that reduces consumer transaction costs. More specifically, we assume that, with $\sigma$ by firm 1, a consumer at location $x$ purchasing from firm 1 will have a reduction of her transaction cost by $s + \lambda x$, where $0 \leq s < \tau$ and $0 \leq \lambda \leq \tau$ (but not $s = \lambda = 0$); or, her utility from purchasing from firm 1 becomes $V + s - p_1 - \mu x$, where $\mu = \tau - \lambda \in [0, \tau]$, and her utility from purchasing from firm 2 remains at $V - p_2 - \tau (1 - x)$ without imitation and becomes $V + s - p_2 - \mu (1 - x)$ after imitation. This formulation allows $\sigma$ to affect consumer transaction costs potentially through two channels: by possibly reducing the coefficient of
shopping cost and by possibly increasing the value of the product to all consumers.

To motivate this formulation, consider the following example. Suppose that the two firms are initially traditional bricks-and-mortar retailers and $\tau$ is simply the unit travel cost for consumers located along the line. In addition to the travel cost, consumers also incur a constant “in-store” transaction cost $\tilde{s}$ for activities such as locating the product and waiting in lines, and $V$ is the consumer valuation inclusive of $\tilde{s}$. Then, $\sigma$ could be an internet store that allows consumers to make the purchase without the need to travel to firm 1, which eliminates the travel cost completely and possibly also reduces the “in-store” transaction cost by $s \in [0, \tilde{s}]$ (perhaps because it is easier to locate the product and there is no need to wait in lines at the internet store). In this example, $s \geq 0$ and $\lambda = \tau$ (or $\mu = 0$). Here, the possible reduction $s$ is similar to a product innovation that increases the value of the product to all consumers in the same way; but the elimination of $\lambda x = \tau x$ affects different consumers differently, since the value of this cost reduction depends on $x$ and since the consumer at location $x$ still incurs travel cost $\tau (1 - x)$ to purchase from firm 2.

More generally, our formulation allows the possibility that $0 < \lambda < \tau$, or $0 < \mu < \tau$. That is, $\sigma$ reduces the coefficient of shopping cost, $\tau$, as in the example above, but may not reduce it to zero. Consider a world where consumers differ both in their intrinsic preferences for the two products and in their transaction costs, and a consumer who likes product $j$ more also has lower transaction cost to purchase from firm $j$. More specifically, to purchase from firm 1 consumer $x$ incurs both utility loss $\mu x$ due to imperfect preference matching and transaction cost $\tilde{s} + \lambda x$, where $\tilde{s}$ is again embedded in $V$. Thus $\tau = \mu + \lambda$. This can happen, for instance, if a consumer prefers to shop at a closer location, not only due to the lower travel cost but also due to a desire to support a local business; as a result consumers with lower transaction costs (travel costs) to a firm also like the firm’s product better. Hence, if $\sigma$ is a new online ordering system for a bricks-and-mortar store, the savings in transaction costs could occur both because consumer at $x$ no longer needs to travel to the store (saving $\lambda x$) and because the transaction itself is easier (e.g., there is no waiting lines, saving $s$); but the consumers’ intrinsic preferences towards the two stores have not changed (and thus cost $\mu x$ remains). Alternatively, it is possible that a consumer is more familiar with a firm (spending more
time on the firm’s website) if she likes the firm’s product more, and familiarity leads to lower transaction cost for the consumer. In this case, suppose that both firms are internet stores and \( \sigma \) is a new trading technology, such as Amazon.com’s “one-click” online ordering process, that simplifies the transaction. Then, it is plausible that, to purchase from firm 1 after \( \sigma \), consumer \( x \) will only incur a fixed amount of transaction cost, \( s - \hat{x} \) (instead of the previous transaction cost \( \hat{s} + \lambda x \)), regardless of her familiarity with firm 1 (or firm 1’s website); but her intrinsic preferences towards the two firms’ products are not changed.

The possible states of innovation are now \( (\phi_1, \phi_2) \in \{(0,0), (\sigma, 0), (\sigma, \sigma)\} \), representing the state of \( \sigma \) by neither firm, of \( \sigma \) by firm 1 only, and of \( \sigma \) by both firms. Everything else is the same as in the previous section.

For the instantaneous games where only firm 1 implements \( \sigma \), the marginal consumer \( \hat{x} \) is determined by \( V + s - p_1 - \mu \hat{x} = V - p_2 - \tau (1 - \hat{x}) \), or \( \hat{x} = \frac{p_2 - p_1 + \tau + s}{\tau + \mu} \). The instantaneous profits of firms 1 and 2 are \( \pi_1 = (p_1 - c) \hat{x} \) and \( \pi_2 = (p_2 - c) (1 - \hat{x}) \). The equilibrium prices of firms 1 and 2, \( p_1 (\sigma, 0) \) and \( p_2 (\sigma, 0) \), satisfy the first-order conditions:

\[
\begin{align*}
   p_2 - p_1 + \tau + s - p_1 + c & = 0, \\
   p_1 - p_2 + \mu - s - p_2 + c & = 0.
\end{align*}
\]

Thus

\[
\begin{align*}
   p_1 (\sigma, 0) & = c + \frac{1}{3} (2 \tau + \mu + s), \\
   p_2 (\sigma, 0) & = c + \frac{1}{3} (\tau + 2 \mu - s),
\end{align*}
\]

and \( \hat{x} = \frac{1}{3} \frac{2 \tau + \mu + s}{\tau + \mu} \).

We note that \( p_2 (\sigma, 0) < p_2 (0, 0) = c + \tau \) and \( p_1 (\sigma, 0) - s < p_1 (0, 0) = c + \tau \), which implies that \( \sigma \) by firm 1 results in higher surpluses for all consumers. The equilibrium instantaneous profits of firms 1 and 2 are \( \pi_1 (\sigma, 0) = \frac{1}{9} \frac{(2 \tau + \mu + s)^2}{\tau + \mu} \) and \( \pi_2 (\sigma, 0) = \frac{1}{9} \frac{\tau + 2 \mu - s)^2}{\tau + \mu} \).

Next, for all possible subgames where both firms have implemented \( \sigma \), the analysis is the same as in the standard Hotelling model with the coefficient of shopping cost as \( \mu \). Thus,
similar to Section 2, \( p_i(\sigma, \sigma) = c + \mu \) and \( \pi_i(\sigma, \sigma) = \frac{1}{2}\mu \). Define

\[
\begin{align*}
  s_1(\mu) &= \frac{3}{2} \sqrt{2} \sqrt{\tau \mu + \tau^2} - \mu - 2\tau \\
  s_2(\mu) &= \tau + 2\mu - \frac{3}{2} \sqrt{2} \sqrt{\tau \mu + \mu^2}
\end{align*}
\]

(11) (12)

Lemma 1 (i)

\[ \pi_1(\sigma, 0) - \pi_1(0, 0) \begin{cases} \geq 0 & \text{if } s \leq s_1(\mu) \\ \leq 0 & \text{if } s \geq s_1(\mu) \end{cases} \]

where \( 0 \leq s_1(\mu) < \frac{\tau}{2} \) and \( s_1(\mu) = 0 \) if and only if \( \mu = \tau \).

(ii)

\[ \pi_2(\sigma, \sigma) - \pi_2(\sigma, 0) \begin{cases} \geq 0 & \text{if } s \geq s_2(\mu) \\ \leq 0 & \text{if } s \leq s_2(\mu) \end{cases} \]

where \( 0 \leq s_2(\mu) \leq \tau \) and \( s_2(\mu) = 0 \) if and only if \( \mu = \tau \). Furthermore, \( s_2(\mu) \geq s_1(\mu) \), where the inequality holds strictly for any \( \mu < \tau \).

Proof. See the appendix.

We shall sometimes denote \( s_1(\mu) \) and \( s_2(\mu) \) simply by \( s_1 \) and \( s_2 \). Define

\[ T^\sigma \equiv \frac{1}{r} \ln \left( \frac{2s^2 + s(8\tau + 4\mu) + (\tau - \mu)(8\tau + 7\mu)}{2s^2 + s(8\tau + 4\mu) - (\tau - \mu)(\tau + 2\mu)} \right), \]

where \( T^\sigma > 0 \) if \( \mu < \tau \).

Proposition 2 Assume that \( \sigma \) is the possible marketing innovation at time 0, and let \( V^\sigma(T) \) denote the equilibrium value of \( \sigma \) to firm 1, excluding \( k \). Then

\[
V^\sigma(T) = \begin{cases} 
\frac{(2\tau + \mu + s)^2}{2r(\tau + \mu)} - \frac{\tau}{2r} & \text{if } s < s_1 \\
\frac{(2\tau + \mu + s)^2(1 - e^{-rT})}{9r(\tau + \mu)} + \frac{\mu e^{-rT} - \tau}{2r} & \text{if } s \geq s_1 
\end{cases}
\]

where if \( s < s_1 \), \( V^\sigma(T) < 0 \); if \( s_1 < s < s_2 \), \( V^\sigma(T) > 0 \); and if \( s \geq s_2 \), \( V^\sigma(T) > 0 \) for \( T > T^\sigma \) and \( V^\sigma(T) < 0 \) for \( T < T^\sigma \). Furthermore, \( V^\sigma(T) \) is independent of \( T \) for \( s < s_2 \) and increases in \( T \) for \( s \geq s_2 \).

Proof. See the appendix.

We notice that \( V^\sigma(T) \) is independent of \( T \) and is negative when \( s < s_1 \); and \( s_1 > 0 \) if \( \mu < \tau \). We thus immediately have the following:
Remark 3 It is possible that the value of a marketing innovation is negative even if imitation is not possible ($T = \infty$).

In the previous section, we have seen that $V^\gamma (T) < 0$ if $T < \frac{\ln s}{r}$, and we noted that this suggests a feature of marketing innovation possibly different from the usual innovations. The fact that it is possible to have $V^\sigma (T) < 0$ for any $T$ further highlights the potential difference between marketing innovation and product or process innovations. To understand this difference, we can again write

$$V^\sigma (T) = \frac{1}{r} \left[ \pi_1(\sigma, 0) - \pi_1 (0, 0) + (\pi_1(\sigma, \sigma) - \pi_1(\sigma, 0)) e^{-rT} \right].$$

Same as for $V^\gamma (T)$, there are the invention effect $\pi_1(\sigma, 0) - \pi_1 (0, 0)$ and the imitation effect $\pi_1(\sigma, \sigma) - \pi_1(\sigma, 0)$. As before, the imitation effect is negative. However, while the invention effect is positive for $\gamma$, or $\pi_1(\gamma, 0) - \pi_1 (0, 0) = \frac{9}{16} \tau - \frac{1}{2} \tau = \frac{1}{16} \tau > 0$, it can be negative for $\sigma$ here since $\pi_1(\sigma, 0) - \pi_1 (0, 0) < 0$ if $s < s_1$, in which case $V^\sigma (T) < 0$ for any $T$.

Same as $\gamma$, innovation $\sigma$ increases the innovating firm’s ability to extract consumer surplus but causes the competitive response of the rival with lower prices. But for $\sigma$ the negative competitive-response effect can dominate the positive extracting-surplus effect even before the imitation of $\sigma$. Importantly, the reductions of $s$ and $\lambda x$ affect firm 1 very differently. Reduction $s$ affects firm 1 more like a product (or process) innovation: it gives firm 1 a competitive advantage before $\sigma$ is imitated by firm 1 but this advantage disappears after the imitation; and it benefits firm 1 even though it also causes firm 2 to respond with lower prices. Reduction $\lambda x$, however, differs fundamentally from product (or process) innovations in that the competitive response of firm 2 leads to lower profit for firm 1, even without firm 2’s imitation. When $s$ is small enough ($s < s_1$), the effect of reduction $\lambda x$ dominates, which explains why for $\sigma$ even the invention effect is sometimes negative.\(^{12}\)

Interestingly, $V^\sigma (T)$ may be non-monotonic in $s$: it is negative for $s < s_1$, is positive for $s_1 < s < s_2$, and can be negative again for $s > s_2$. This non-monotonicity relationship is due to the following insight: While the negative competitive response may reduce the incentive for firm 1 to introduce $\sigma$, it can also reduce the incentive for firm 2 to imitate; and as a result, firm 2 may not want to imitate $\sigma$! In fact, when $s_1 < s < s_2$, firm 2 has no
incentive to imitate, which increases firm 1’s incentive to innovate. But when \( s > s_2 \), firm 2 will imitate firm 1’s innovation, which can make it not profitable for firm 1 to innovate if \( T \) is not big enough.

We now return to the relationship between competition and the incentives for marketing innovation. We have:

**Corollary 1** The value of \( \sigma \) to the innovating firm is lower if \( \tau \) is higher.

**Proof.** See the appendix.

Thus, unlike for \( \gamma \), where a higher \( \tau \) increases \( V^\gamma (T) \), here we have the opposite result: a higher \( \tau \) reduces \( V^\sigma (T) \). Again, we may view \( \tau \) as a measure of the competitiveness of the market (before \( \sigma \)), since \( p_i (0,0) \) is higher with \( \tau \); and it is intriguing to see the effect of competition on innovation incentives depends so dramatically on the nature of the marketing innovation. The economic intuition for the negative correlation between \( V^\sigma (T) \) and \( \tau \) seems to be the following: A higher \( \tau \) leads to higher profit without \( \sigma \). But for any given \( \mu \), a higher \( \tau \) also means that the market becomes relatively more competitive after \( \sigma \), and hence there is less benefit from the innovation. We thus have:

**Remark 4** Reducing the intensity of competition (reducing \( \tau \)) increases the incentive for marketing innovation \( \gamma \) but decreases the incentive for marketing innovation \( \sigma \).

5. Comparing Private and Social Incentives

We now address the policy issue: From the society’s point of view, is there too much or too little marketing innovation? We shall assume that the objective of a society is to maximize social surplus.

Consider first the marketing innovation on a new information technology, \( \gamma \). Since social surplus is the same in states \((0,0)\) and \((\gamma, \gamma)\) but is lower in state \((\gamma, 0)\) due to the higher total transactions costs under \((\gamma, 0)\), the private incentive exceeds the social incentive in the case of \( \gamma \). But this result is easily anticipated given the fact that in our model total output is fixed. Marketing innovation \( \gamma \) causes an output diversion from firm 2 to firm 1
with increased consumer transaction costs, but it causes no output creation even though it leads to lower prices in the market. If consumer demand were not fully inelastic, then the lower price caused by $\gamma$ would also positively affect social surplus by reducing consumer deadweight losses, which would need to be taken into account in evaluating the welfare effects of $\gamma$.\textsuperscript{13} Nevertheless, as long as consumer demand is sufficiently inelastic, our result would be valid.

Consider next the marketing innovation that reduces consumer transaction costs, $\sigma$. If the decision of imitation is also made socially, then it would be socially optimal to adopt $\sigma$ for firm 2 when $\sigma$ is available (albeit with delay $T$ that is also necessary), and the social value of $\sigma$ in this case would be

$$W = \int_0^T \left[ \int_0^{\hat{x}} (V + s - \mu x) \, dx + \int_{\hat{x}}^1 (V - \tau(1 - x)) \, dx - 2 \int_0^{\hat{x}} (V - \tau x) \, dx \right] e^{-rt} \, dt$$

$$+ \int_T^\infty 2 \int_0^{\hat{x}} ((V + s - \mu x) - (V - \tau x)) \, dx e^{-rt} \, dt,$$

where $\hat{x} = \frac{1}{3} \frac{2r + \mu + s}{r + \mu}$.

If, on the other hand, the decision on imitation is made privately but the decision on innovation is made socially, the social value of $\sigma$ would be

$$W = \begin{cases} \frac{1}{r} \left[ \int_0^{\hat{x}} (V + s - \mu x) \, dx + \int_{\hat{x}}^1 (V - \tau(1 - x)) \, dx - 2 \int_0^{\hat{x}} (V - \tau x) \, dx \right] & \text{if } s < s_2 \\ \frac{W}{\mathcal{W}} & \text{if } s \geq s_2 \end{cases}.$$ 

**Proposition 3** $W - V^\sigma(T) \geq \mathcal{W} - V^\sigma(T) > 0$.

**Proof.** See the appendix.

Therefore, for $\sigma$ the social incentive exceeds the private incentive. The reason for this seems to be the following: The reduction in transaction costs is always socially beneficial. The innovating firm benefits from the cost reduction, which makes its product more attractive to consumers, but it also suffers from the competitive response of the rival in the form of reduced prices. This loss due to the rival’s competitive response is a private cost but not a social cost, resulting in the private incentive for $\sigma$ to be below the social incentive. We also notice that firm 2 may not imitate if the imitation decision is made privately, in which case $\mathcal{W} > W$, and thus $W - V^\sigma(T) \geq \mathcal{W} - V^\sigma(T)$. 

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To summarize, we have:

**Proposition 4** Relative to the socially optimal level, the private incentive is too high for $\gamma$ but too low for $\sigma$.

In recent years, there have been growing interests in the issue of whether business method innovations should receive patent protection; such protection can increase $T$ (delaying possible imitation) and potentially increase the private benefit of innovation. To the extent that we may consider marketing innovation as an important form of business method innovations, our analysis provides a framework to address this issue.$^{14}$ For certain marketing innovation, such as $\gamma$ here, patent protection would not be socially desirable since the private incentive is already too high. For marketing innovations for which private incentive is too low, such as $\sigma$ here, while patent protection can increase private innovating incentives in some situations (when $s > s_2$), it is also possible that such protection has no effect on these incentives (when $s < s_2$, where $V^\sigma(T)$ is independent of $T$).$^{15}$

To focus on the value of innovation to a single firm, we have assumed in this paper that only one firm has the opportunity to conduct marketing innovation. Naturally, it would be interesting to know whether and how our analysis will change if our model is extended so that both firms have opportunities to innovate. It appears that, for the extensions discussed below, our basic results concerning the desirability of patent protections for $\gamma$ and for $\sigma$ remain essentially the same if both firms can innovate.

Suppose that everything is the same as in Sections 2 and 3, except that firm 2 also has the opportunity to introduce $\gamma$ with fixed cost $k$, and the innovating opportunity arrives for each firm stochastically and independently, perhaps following a Poisson process. Assume that unless a firm introduces $\gamma$, whether it has the opportunity to do so is its private information; and that after one firm introduces $\gamma$, another firm can imitate the innovation with delay time $T$. Then, it appears that the following can be true in equilibrium: If $T$ is sufficiently large, $k$ is sufficiently small, and the arrival rate of innovating opportunity is low, each firm will introduce $\gamma$ when it has the opportunity to do so. If $T$ is small, on the other hand, there could be multiple equilibria if the arrival rate of innovating opportunity is
high: in one equilibrium no firm ever introduces $\gamma$, which is essentially a collusive outcome sustained by the threat of a quick response to deviation (quick imitation); and in another equilibrium each firm always introduces $\gamma$ when it has the opportunity to do so (the non-collusive outcome). Thus, the equilibrium outcome in Section 3, where the firm with the innovating ability will introduce $\gamma$ when $T$ is sufficiently large and $k$ sufficiently small, and where $\gamma$ is not introduced when $T$ is small, can also be an equilibrium outcome in this extended model. Furthermore, since the effect of patent protection is effectively increasing $T$, such protection could increase the incentives for each firm to introduce $\gamma$ in this extended model; but since the private incentive for $\gamma$ is already too high, the patent protection will not be socially desirable, same as if only one firm can possibly innovate.

If we again consider this extended model but the possible innovation is $\sigma$, then the following appears to be true in equilibrium. If $s < s_1$, we have the same result as in the basic model: no firm introduces $\sigma$, and patent protection has no effect on the firms’ innovation incentives. If $s_1 < s < s_2$, each firm will introduce $\gamma$ when it has the opportunity to do so, provided that $k$ is small. This outcome is, as in our basic model, again not affected by patent protection. Finally, if $s > s_2$, a higher $T$ could increase each firm’s innovation incentive, and patent protection can thus have a positive impact on social welfare, which is again similar to the result when only firm 1 can innovate.

6. Concluding Remarks

This paper has taken a first look at marketing innovation, the development of new marketing tools and methods. We have studied two commonly observed forms of marketing innovation: $\gamma$, which allows a firm to acquire consumer information (target consumers) more effectively; and $\sigma$, which reduces consumer transaction costs. The incentives and effects of marketing innovation differ markedly from those of product or process innovations. While $\gamma$ benefits the innovating firm, it hurts some consumers; and, while $\sigma$ benefits all consumers, it may or may not benefit the innovating firm. Interestingly, the simultaneous adoption of $\gamma$ or $\sigma$ by all firms would reduce industry profit. However, the industry equilib-
rium differs from the Prisoner’s Dilemma outcome, since the marketing innovation occurs if and only if the innovating firm benefits from the innovation, which is only possible if there is sufficient delay for imitation. An increase in competition intensity reduces the value of $\gamma$ but increases the value of $\sigma$. Relative to the socially optimal level, the private incentive is too high for $\gamma$ but too low for $\sigma$.

As is typical in the Hotelling framework, our model has the feature that total industry output is fixed and firms are always in direct competition. It is possible to extend this model so that market demand is not entirely inelastic. For instance, suppose that we add two additional lines to our basic model, $l_1$ and $l_2$, originating from firm 1 towards its left and from firm 2 towards its right, respectively, and the length of $l_i$ is larger than 1. A mass of $\beta (> 0)$ consumers are uniformly distributed on $l_i$, who will only purchase from firm $i$ and each of whom has unit demand with valuation $V = c + 2\tau$. Firm $i$ treats $l_i$ as a separate market, and a consumer on $l_i$ with distance $x_i$ to firm $i$ incurs transaction cost $\tau x_i$ to purchase from firm $i$. Then, without $\gamma$ firm $i$ will set $p_i = c + \tau$ to consumers on $l_i$ and not all consumers on $l_i$ will purchase. And with $\gamma$, firm 1 will sell more quantities and also extract higher surpluses from consumers on $l_1$, and similarly for firm 2 from consumers on $l_2$ after imitating $\gamma$. With this modification of our model, $\gamma$ will have the additional output expansion/surplus extraction effects for firm 1 on $l_1$ (and for firm 2 on $l_2$ when imitation occurs). It is then easy to see that this will increase $V^\gamma(T)$, and it becomes possible (when $\beta$ is large) that the instantaneous industry profit will increase (the sum of the invention and imitation effects is positive) if $\gamma$ were to be adopted simultaneously by both firms. The same can be true for $\sigma$. Furthermore, in this modified model the private incentive for $\gamma$ could be too low, since the innovation of $\gamma$ has a positive externality through the expansion of output on $l_2$ when firm 2 imitates $\gamma$, and firm 1 does not internalize this positive externality. Notice that in this modified model, the properties of marketing innovation are more similar to those of the usual product and process innovations.

The results of our model are thus most relevant in situations where firms compete directly and marketing innovation causes significantly more output diversion than output expansion. By formulating our model in a setting where total industry output is fixed and firms are in
direct competition, we highlight the features of marketing innovation that are more likely to be different from those of the usual product/process innovations; and, without the need to consider the change in industry output, the exposition is also simpler.

There are other directions to extend our analysis. For instance, it would be interesting to extend our model to settings with many firms or with asymmetric firms (such as an incumbent and an entrant), which will enable us to address the question of whether a more concentrated market or a larger firm offers more incentive for marketing innovation.\textsuperscript{18} As another interesting direction for future research, firms may each introduce a different marketing innovation, and the arrival rate of opportunities or ideas for marketing innovation to a firm may depend on the firm’s expenditures on marketing research. Our analytic framework can also be used to understand the incentives for and the effects of other forms of marketing innovation, such as new methods of advertising that provide product information to consumers more effectively, new ways of product bundling, or new forms of selling institutions. Such analysis would lead to richer theories of markets where firms compete in multi-dimensions. To the extent that the marketing of products and services represents an important part of economic activities in an economy, more research on the economics of marketing innovation is warranted.

REFERENCES


APPENDIX

The proofs for Proposition 1, Lemma 1, Proposition 2, Corollary 1, and Proposition 3 follow.

**Proof of Proposition 1.** We first notice that the profits of both firms in each of the three types of instantaneous games are results of unique Nash equilibrium strategies of these firms in these games. Next, since

\[
\pi_2(\gamma, \gamma) = \frac{1}{4} \tau > \frac{1}{8} \tau = \pi_2(\gamma, 0),
\]

firm 2 will imitate if firm 1 innovates. Thus, a unique (subgame) perfect equilibrium exists where firm 1 will introduce \(\gamma\) if and only if \(V^\gamma(T) \geq k\), where

\[
V^\gamma(T) = \int_0^T \pi_1(\gamma, 0) e^{-rt} dt + \int_T^\infty \pi_1(\gamma, \gamma) e^{-rt} dt - \int_0^\infty \pi_1(0, 0) e^{-rt} dt
\]

\[
= \int_0^T \frac{9}{16} T e^{-rt} dt + \int_T^\infty \frac{1}{4} T e^{-rt} dt - \int_0^\infty \frac{1}{2} e^{-rt} dt = \frac{1}{16r} \tau \left(1 - 5e^{-rT}\right).
\]

It follows that \(V^\gamma(T) \geq 0\) if and only if \(T \geq \frac{\ln 5}{r}\).  

**Proof of Lemma 1.** (i)

\[
\pi_1(\sigma, 0) - \pi_1(0, 0) = \frac{1}{9} \frac{(2\tau + \mu + s)^2}{\tau + \mu} - \frac{1}{2} \tau
\]

\[
= \frac{1}{18} \frac{2s^2 + s(8\tau + 4\mu) - (\tau - \mu)(\tau + 2\mu)}{\tau + \mu} \geq 0 \text{ if } s \geq s_1(\mu),
\]

since \(s_1(\mu)\) solves

\[
2s^2 + s(8\tau + 4\mu) - (\tau - \mu)(\tau + 2\mu) = 0,
\]

and

\[
\frac{\partial}{\partial s} (2s^2 + s(8\tau + 4\mu) - (\tau - \mu)(\tau + 2\mu)) = 4s + 8\tau + 4\mu > 0.
\]

Also, since for \(s = 0\), \(2s^2 + s(8\tau + 4\mu) - (\tau - \mu)(\tau + 2\mu) \leq 0\), where the equality holds if and only if \(\tau = \mu\); and

\[
2 \left(\frac{T}{4}\right)^2 + \frac{\tau}{4} (8\tau + 4\mu) - (\tau - \mu)(\tau + 2\mu) = \frac{9}{8} \tau^2 + 2\mu^2 > 0,
\]

\[
\frac{\pi_2(\gamma, \gamma) - \pi_2(\gamma, 0)}{\tau} = \frac{1}{4} > \frac{1}{8} = \frac{\pi_2(\gamma, 0)}{\tau},
\]

where apparition of the \(\pi_2\) notation is by difference. 

\[
\frac{\pi_2(\gamma, \gamma) - \pi_2(\gamma, 0)}{\tau} > \frac{\pi_2(\gamma, 0)}{\tau}.
\]
we have $0 \leq s_1(\mu) < \frac{\tau}{4}$, and $s_1(\mu) = 0$ if and only if $\mu = \tau$.

(ii) 

$$
\pi_2(\sigma, \sigma) - \pi_2(\sigma, 0) = \frac{1}{2} \mu - \frac{1}{9} \left( \frac{\tau + 2\mu - s}{\tau + \mu} \right)^2 
= \frac{1}{18} \left( 4\tau + 8\mu - 2s \right) \left( \tau - \mu \right) \left( 2\tau + \mu \right) \geq 0 \iff s \leq s_2(\mu),
$$

since $s_2(\mu)$ solves 

$$
\left( 4\tau + 8\mu - 2s \right) \left( \tau - \mu \right) \left( 2\tau + \mu \right) = 0
$$

and 

$$
\frac{\partial}{\partial s} \left( 4\tau + 8\mu - 2s - \left( \tau - \mu \right) \left( 2\tau + \mu \right) \right) = 4(\tau - s) + 8\mu > 0.
$$

It can be easily verified that $0 \leq s_2(\mu) \leq \tau$, and $s_2(\mu) = 0$ if and only if $\mu = \tau$. Furthermore, since 

$$
\pi_1(\sigma, 0) - \pi_1(0, 0) - (\pi_2(\sigma, \sigma) - \pi_2(\sigma, 0))
= \frac{1}{18} \left( 4\tau + 8\mu - 2s \right) \left( \tau + \mu \right)^2 
= \frac{1}{18} \left( 4\tau + 8\mu + \left( \tau - \mu \right)^2 \right) \geq 0,
$$

we have $s_2(\mu) \geq s_1(\mu)$, where the inequality holds strictly for any $\mu < \tau$. \hfill \Box

**Proof of Proposition 2.** Since 

$$
\pi_2(\sigma, \sigma) - \pi_2(\sigma, 0) \geq 0 \iff s \leq s_2,
$$

firm 2 will not imitate $\sigma$ if $s < s_2$. Thus, since $s_1 \leq s_2$, if $s < s_1$ or if $s_1 < s < s_2$, we have 

$$
V^\sigma(T) = \left[ \pi_1(\sigma, 0) - \pi_1(0, 0) \right] \frac{1}{r} = \frac{\left( 2\tau + \mu + s \right)^2}{9r(\tau + \mu)} - \frac{\tau}{2r} \begin{cases} < 0 & \text{if } s < s_1, \\ > 0 & \text{if } s_1 < s < s_2. \end{cases}
$$

Obviously $V^\sigma(T)$ is independent of $T$ when $s < s_2$. 

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Next, if \( s \geq s_2 \), firm 2 will imitate \( \sigma \), and thus

\[
V^\sigma (T) = \int_0^T \pi_1 (\sigma, 0) e^{-rt} dt + \int_T^\infty \pi_1 (\sigma, \sigma) e^{-rt} dt - \int_0^\infty \pi_1 (0, 0) e^{-rt} dt
\]

\[
= \int_0^T \frac{1}{9} \frac{(2\tau + \mu + s)^2}{\tau + \mu} e^{-rt} dt + \int_T^\infty \frac{1}{2} \mu e^{-rt} dt - \int_0^\infty \frac{1}{2} \tau e^{-rt} dt
\]

\[
= \frac{(2\tau + \mu + s)^2 (1 - e^{-rT})}{9r (\tau + \mu)} + \frac{(\mu e^{-rT} - \tau)}{2r}.
\]

Rearranging the terms, we further have

\[
V^\sigma (T) = \frac{1}{9r} \frac{(2\tau + \mu + s)^2}{\tau + \mu} - \frac{1}{2r} \tau + \left( \frac{1}{2r} \mu - \frac{1}{9r} \frac{(2\tau + \mu + s)^2}{\tau + \mu} \right) e^{-rT}
\]

\[
= \frac{2s^2 + s (8\tau + 4\mu) - (\tau - \mu) (\tau + 2\mu) - (2s^2 + s (8\tau + 4\mu) + (\tau - \mu) (\tau + 7\mu)) e^{-rT}}{18r (\tau + \mu)}
\]

\[
\geq 0 \text{ if and only if } T \geq \frac{1}{r} \ln \left( \frac{2s^2 + s (8\tau + 4\mu) + (\tau - \mu) (\tau + 7\mu)}{2s^2 + s (8\tau + 4\mu) - (\tau - \mu) (\tau + 2\mu)} \right) \equiv T^\sigma,
\]

and \( V^\sigma (T) \) increases in \( T \).

**Proof of Corollary 1.** If \( s < s_2 \),

\[
\frac{\partial V^\sigma (T)}{\partial \tau} = \frac{\partial}{\partial \tau} \left( \frac{2s^2 + s (8\tau + 4\mu) - (\tau - \mu) (\tau + 2\mu)}{18r (\tau + \mu)} \right) = -\frac{2\tau \mu + \tau^2 + \mu^2 + 2 (\mu - s)^2}{18 (\tau + \mu)^2 r} < 0.
\]

If \( s > s_2 \)

\[
\frac{\partial V^\sigma (T)}{\partial \tau} = \frac{\partial}{\partial \tau} \left( \frac{(2\tau + \mu + s)^2 (1 - e^{-rT})}{9r (\tau + \mu)} + \frac{(\mu e^{-rT} - \tau)}{2r} \right)
\]

\[
\leq \frac{(s + 2\tau + \mu) (2\tau + 3\mu - s)}{9 (\tau + \mu)^2 r} (1 - e^{-rT}) - \frac{1}{2r}
\]

\[
\leq \frac{(s + 2\tau + \mu) (2\tau + 3\mu - s)}{9 (\tau + \mu)^2 r} - \frac{1}{2r}
\]

\[
= \frac{1}{18} \frac{2\tau \mu + \tau^2 + \mu^2 + 2 (\mu - s)^2}{(\tau + \mu)^2 r} < 0.
\]

Therefore \( \frac{\partial V^\sigma (T)}{\partial \tau} < 0 \).
Proof of Proposition 3. With \( \hat{x} = \frac{1}{3} \frac{2x + \mu + s}{\tau + \mu} > \frac{1}{2} \),

\[
\mathcal{W} = \int_0^T \left[ \int_0^t \frac{1}{3} \frac{2x + \mu + s}{\tau + \mu} (V + s - \mu x) \, dx + \int_0^1 \frac{1}{3} \frac{2x + \mu + s}{\tau + \mu} (V - \tau(1 - x)) \, dx - 2 \int_0^{\frac{1}{2}} (V - \tau x) \, dx \right] e^{-rt} \, dt
\]

\[
+ \int_T^\infty 2 \int_0^{\frac{1}{2}} [(V + s - \mu x) - (V - \tau x)] \, dx e^{-rt} \, dt
\]

\[
> \int_0^\infty \left[ \int_0^{\frac{1}{3}} \frac{2x + \mu + s}{\tau + \mu} (V + s - \mu x) \, dx + \int_0^1 \frac{1}{3} \frac{2x + \mu + s}{\tau + \mu} (V - \tau(1 - x)) \, dx - 2 \int_0^{\frac{1}{2}} (V - \tau x) \, dx \right] e^{-rt} \, dt
\]

\[
= \frac{28s\tau + 8s\mu - 5\tau\mu + 10s^2 + 7\tau^2 - 2\mu^2}{36r(\tau + \mu)}.
\]

Thus, \( \mathcal{W} \leq \mathcal{W} \) since

\[
\mathcal{W} = \begin{cases} 
\frac{28s\tau + 8s\mu - 5\tau\mu + 10s^2 + 7\tau^2 - 2\mu^2}{36r(\tau + \mu)} & \text{if } s < s_2 \\
\mathcal{W} & \text{if } s \geq s_2
\end{cases}
\]

From the proof of Proposition 2, we have:

\[
V^\sigma(T) \leq \frac{(2\tau + \mu + s)^2}{9r(\tau + \mu)} - \frac{\tau}{2r},
\]

and thus

\[
\mathcal{W} - V^\sigma(T) \geq \frac{28s\tau + 8s\mu - 5\tau\mu + 10s^2 + 7\tau^2 - 2\mu^2}{36r(\tau + \mu)} - \left( \frac{(2\tau + \mu + s)^2}{9r(\tau + \mu)} - \frac{\tau}{2r} \right)
\]

\[
= \frac{4s\tau + 2s^2 + (\tau - \mu)(3\tau + 2\mu)}{12(\tau + \mu)r} > 0.
\]

Therefore \( \mathcal{W} - V^\sigma(T) \geq \mathcal{W} - V^\sigma(T) > 0. \)
Notes

1 One feature that is common to marketing innovation and product or process innovations is that a firm’s innovation hurts the non-innovating rival due to a business-stealing effect.

2 Unlike marketing innovation, there exists an extensive literature on financial innovation. See, for example, Allen and Gale (1994) for a guide to the literature.

3 If we interpret the unit line as the consumers’ preference space, then \( \tau \) would be the coefficient of preference intensity.

4 Our model is thus one of asymmetric innovating abilities. Following Arrow (1962), this approach allows us to study the value of innovation to a firm who is the only one that can potentially innovate. The game would be quite different if both firms were able to innovate, which we shall later discuss.

5 The qualitative nature of our analysis would not change if with \( \gamma \) a firm were able to learn only a portion of the consumers’ locations, or to increase the effectiveness in information acquisition only marginally.

6 In recent years, there have been increasing uses of marketing programs that set prices based on the information of a consumer’s previous purchases, and such practices have been studied extensively (e.g., Chen 1997; Fudenberg and Tirole, 2000; Taylor, 2003; and Villas-Boas, 1999). But in these studies the new marketing method is made simultaneously available to all firms in the market, without considering the fact that it is often initially introduced by one firm.

7 This result is natural in our context due to the fact that firms are always in direct competition and total industry output is fixed. We shall later discuss an extension of our model in which the simultaneous adoption of \( \gamma \) by all firms can increase industry profits.

8 While price discrimination has long existed, some of the innovative consumer targeting methods have occurred only recently as new information technologies become available.

9 For firms with asymmetric market shares or costs, it is possible that a firm can benefit from targeted pricing in static settings (e.g., Shaffer and Zhang, 2000). We may thus interpret our result as due to the fact that the firms in our model are asymmetric in their ability for marketing innovation.

10 For our purpose we have assumed that firm 2 cannot have \( \gamma \) without the innovation of firm 1. As we shall discuss later, our result can also hold if both firms have opportunities to innovate.

11 We assume that once the purchase is made, the product will be delivered with the same delivery cost, whether it is purchased at the retail store or online, as, for instance, if the product is furniture. If the product is something like books, we may assume that the internet store would provide free shipping and be able to offset the shipping cost with savings from lowered retailing costs.

12 If there is fixed cost, however, \( \sigma \) can potentially benefit the innovating firm by inducing the rival’s exit through intensified competition.

13 Since the effect of output expansion under an elastic demand is well understood, for the purpose of this
paper and for convenience we have chosen a model with fixed industry output. Later in the concluding section, we shall discuss a simple extension of our model that allows downward-slopping market demand.

14 A related issue is that if patents are granted for marketing (business methods) innovations, whether a patent holder will have incentives to license the innovation. Obviously the result will depend on whether or not the firms are in direct competition. The possibility of licensing in turn affects the welfare effects of protection for marketing (business methods) innovations.

15 More generally, there are other government interventions that can potentially improve efficiency. For instance, technology exists that allows a consumer to have the same phone number when changing phone companies, which would reduce the consumer’s transaction costs (switching costs) to purchase from her current service provider’s competitor, but firms may not introduce this technology since it can intensify competition, and government regulation is needed to make it happen. See Gans and King (2001) for an economic analysis of this issue.

16 Notice that if only firm 1 can innovate, it will not introduce \( \gamma \) if \( T \) is small, and its profit without \( \gamma \) is \( \pi_1 (0, 0) \). When both firms are able to innovate, firm 1 will receive \( \pi_1 (0, \gamma) < \pi_1 (0, 0) \) when it does not innovate but the other firm does. This can motivate firm 1 (and firm 2) to innovate preemptively. See Katz and Shapiro (1987) for related discussions.

17 We can also consider the possibility that while firm 1 can innovate at time 0, firm 2 is known to be able to innovate with a delay time \( \tilde{T} \). If \( \tilde{T} \) is large enough, the analysis in our basic model would be valid. If \( \tilde{T} \) is small, we could also have multiple equilibria: in one equilibrium each firm immediately innovates when it has the opportunity to do so, and the other equilibrium no firm innovates.

18 This question has been studied extensively in the literature on product (process) innovations. According to Schumpeter (1942), large firms or more concentrated markets are more conducive to innovation. Arrow (1962), however, has pointed out that the value of innovation in cost reduction is higher for a competitive firm than for a monopolist. In comparing the incentive for product innovation by an incumbent monopolist and a potential entrant, on the other hand, Gilbert and Newbury (1982) makes an elegant argument of why a monopolist has the higher incentive.