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Marketing Innovation

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Abstract: This paper provides an economic analysis of marketing innovation. Variants of a dynamic oligopoly model are developed to study two forms of marketing innovation: γ, which allows a firm to acquire consumer information effectively; and σ, which reduces consumer transaction costs. A firm's incentive to innovate depends on an invention effect and an imitation effect. It also depends on market structure and the nature of competition. The innovation incentive is higher for a large firm than for a small firm if imitation is sufficiently difficult, and otherwise the opposite is true. Increased competition reduces the value of γ but may increase the value of σ. Relative to the social optimum, the private incentive is too high for γ but too low for σ.

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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 computer software 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. Despite its obvious importance, and unlike product or process innovation, marketing innovation has received little attention in the economic literature. Important questions that remain to be answered include: What determines a firm's incentive for marketing innovation and how does it compare with those for product or process innovation? How do industry conditions, such as market structure and the nature of competition, affect marketing innovation? And are there too high or too low private incentives for marketing innovation? In this paper, I provide an economic analysis of these issues through variants of a dynamic oligopoly model.

My basic model is a dynamic duopoly where every instantaneous game is a simple extension of the familiar Hotelling model (Hotelling, 1929) and where at time zero a given firm can introduce a marketing innovation, possibly with some fixed (investment) cost. 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 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, γ and σ, where γ is a new technology that allows a firm to acquire consumer information (target consumers) more effectively and to charge individualized prices, and σ is a new trading method that reduces consumer transaction costs. Using the duopoly setting, I show that the value of marketing innovation to the innovating firm depends on what I call an immediate *invention effect* and a delayed *imitation effect*. Similar to product or process innovation, the imitation effect is negative. For marketing innovation, however, the undiscounted sum of these two effects, which would be the change in industry profit if the innovation were simultaneously adopted by all firms, can often be negative. By varying parameters of the duopoly model, I also show how the nature of competition affects a firm's incentive for marketing innovation. In particular, an increase in competition intensity reduces the firm's innovation incentive for γ but can increase its incentive for σ.

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 business method innovations, which also include financial innovation.[1] It is thus important to compare the private and social incentives for marketing innovation. I find that the private incentive is too high for the marketing innovation to acquire consumer information but too low for the marketing innovation to reduce consumer transaction costs. Essentially, the increased ability for the innovating firm to gather consumer information through γ causes inefficient output diversion that is privately beneficial but socially wasteful, while the reduction in consumer transaction costs through σ may intensify competition for the innovating firm, creating a private (but not social) cost.

In the economic literature on product and process innovations, an issue that has been studied extensively is whether a more concentrated market or a larger firm offers more incentive for innovation.[2] It is natural to ask the same question here for marketing innovation. To do this I extend the main model so that every instantaneous game is an oligopoly char-

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

[2] 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.

acterized by a spokes model of multiple firms[3], and at the same time I limit my attention to the innovation that reduces consumer transaction costs. I find that if the imitation delay is above some critical level, the innovation incentive is higher under a more concentrated market or for a larger firm; and otherwise the opposite is true. This suggests that for marketing innovations that are relatively easy to imitate, they are more likely to be introduced by small firms/new entrants and in less concentrated markets, while for marketing innovations that are more difficult to imitate, they are more likely to be introduced by large firms/incumbents and in more concentrated markets.

The rest of the paper is organized as follows. Section 2 sets up the basic model and derives the equilibrium profits of firms without marketing innovation. Section 3 studies the marketing innovation to acquire consumer information. I derive the value of γ to the innovating firm, compare γ with the usual product/process innovations, and discuss how γ is affected by the intensity of competition. Section 4 conducts the parallel analysis for the marketing innovation to reduce consumer transaction costs (σ). Section 5 compares the private and social incentives for marketing innovation. Section 6 extends the analysis to a model where every instantaneous game consists of multiple firms, under the assumption that firms have acquired consumer information but can have the marketing innovation to reduce consumer transaction costs. The issue of how incentives for marketing innovation depend on market structure is addressed. Section 7 concludes by discussing limitations of the paper and possible extensions.

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 $x \in [0, 1]$

[3]The spokes model, developed in Chen and Riordan (2003), describes a differentiated oligopoly with possibly many firms engaging in non-localized price competition.

incurs transaction (transportation) costs τx and $\tau(1-x)$ to purchase from firms 1 and 2, respectively, where τ is the coefficient of consumers' transaction cost (or unit transportation cost). Assume that the firms can separate consumers into two groups, A and B, both of which are uniformly distributed on the line. Any group-A consumer's location on the line is known to both firms, while initially any group-B consumer's location is only known to herself. The portion of group-A consumers is $\alpha \in [0,1)$.[4] No price arbitrage is allowed between consumers and between consumer groups. Assume that $c + \frac{3}{2}\tau < V$ 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 ϕ, with cost $k \geq 0$. The new marketing technology ϕ, 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.[5] 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. Denote the states of innovation by vector (s_1, s_2), where $(s_1, s_2) \in \{(0,0), (\phi, 0), (\phi, \phi)\}$, representing the states of ϕ by neither firm, of ϕ by firm 1 alone, and of ϕ 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

[4] Thus, every instantaneous game reduces to the usual Hotelling model when $\alpha = 0$. As it will become clear later, α serves as a measure of the competitiveness of the market. Our assumption that group-A consumers' locations are known is obviously special, but it is a convenient way of capturing the idea that firms have some information about different types of consumers and possibly their characteristics. For instance, perhaps group A consists of consumers purchasing through the internet and group B consists of consumers purchasing through traditional retailers; or they are respectively the existing and new consumers in the market.

[5] 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.

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 ϕ. We analyze the value of innovation in the subgame perfect equilibrium of this game.

As a preliminary step, we derive the equilibrium prices and profits for both firms where ϕ is not introduced, or where the state is $(0,0)$. For the group-A consumers, the equilibrium prices of firms 1 and 2 are

$$p_1^A(x \mid 0,0) = max\{c, c+\tau(1-2x)\}, \quad (1)$$

$$p_2^A(x \mid 0,0) = max\{c, c+\tau(2x-1)\}, \quad (2)$$

and consumers with $x < \frac{1}{2}$ and with $x > \frac{1}{2}$ purchase from firm 1 and firm 2, respectively.

For the group-B consumers, the usual Hotelling analysis tells us that the unique equilibrium price strategies for firms $i = 1, 2$ are

$$p_i^B(0,0) = c + \tau,$$

and consumers' purchases are again equally divided between the two firms. Thus, the equilibrium instantaneous profits of the two firms in state $(0,0)$ are:

$$\pi_i(0,0) = \alpha \int_0^{\frac{1}{2}} [c + \tau(1-2x) - c]\, dx + (1-\alpha)\frac{1}{2}\tau = \frac{1}{4}\tau(2-\alpha). \quad (3)$$

3. Acquiring Consumer Information

In this section, we consider a particular type of marketing innovation, the development of a new information technology that improves the effectiveness of consumer targeting. We denote this innovation by γ (i.e., $\phi = \gamma$). Specifically, with γ a firm is able to learn the locations of every consumer in group B (and hence of all consumers since the locations of group-A consumers are already known).[6] For instance, γ may be a new software that

[6]The qualitative nature of our analysis would not change if with γ a firm were able to learn only a portion of the consumers' locations in group B, or to increase the effectiveness in information acquisition only marginally.

tracks consumer information effectively, or γ may be a new method of gathering consumer information that allows the firm to charge individual prices to different consumers.[7]

Consider first instantaneous games where only firm 1 implements γ. At every instant, the two firms play a game where we denote firm 1's equilibrium strategy by $p_1^j(x \mid \gamma, 0)$ for $j = A, B$ and firm 2's equilibrium strategy by $p_2^A(x \mid \gamma, 0)$ and $p_2^B(\gamma, 0)$. Then, for consumers in group A, the equilibrium prices of firms 1 and 2 are the same as those given by equations (1) and (2).

For consumers in group B, the marginal consumer is determined by

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

Or

$$\hat{x} = \frac{p_2^B - c}{2\tau} + \frac{1}{2}.$$

Firms 1 sells to consumers of $x < \hat{x}$ with

$$p_1^B(x \mid \gamma, 0) = max\left\{c,\ p_2^B(\gamma, 0) + \tau(1 - 2x)\right\},$$

while firm 2 sells to all consumers of $x > \hat{x}$ with profit

$$\pi_2 = \left(p_2^B - c\right)(1 - \hat{x}) = \left(p_2^B - c\right)\left(\frac{1}{2} - \frac{p_2^B - c}{2\tau}\right),$$

where $p_2^B(\gamma, 0)$ satisfies the first-order condition:

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

or

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

[7] In recent years, for instance, 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 marketing method is made simultaneously available to all firms in the market, without considering the fact that it is sometimes initially introduced by a single firm.

Thus,

$$p_1^B(x \mid \gamma, 0) = max\left\{c, c + \frac{3\tau}{2} - 2\tau x\right\},$$
$$\hat{x} = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}.$$

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

$$\pi_1(\gamma, 0) = \alpha\frac{1}{4}\tau + (1-\alpha)\int_0^{\frac{3}{4}}\left(c + \frac{3\tau}{2} - 2\tau x - c\right)dx = \frac{1}{16}\tau(9 - 5\alpha), \tag{4}$$

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

Consider next the possible instantaneous games where both firms have implemented the new information technology, or in state (γ, γ). The equilibrium prices for a consumer at location x in state (γ, γ) will be

$$p_1(x \mid \gamma, \gamma) = max\{c, c + \tau(1 - 2x)\},$$
$$p_2(x \mid \gamma, \gamma) = max\{c, c + \tau(2x - 1)\},$$

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 (γ, γ) thus are:

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

We have:

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

$$V^\gamma(T) = \frac{1}{16}\tau\left(1 - 5e^{-rT}\right)\frac{1-\alpha}{r}, \tag{7}$$

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

Proof. 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

$$\pi_2(\gamma, \gamma) = \frac{1}{4}\tau > \frac{1}{8}\tau(\alpha + 1) = \pi_2(\gamma, 0),$$

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

$$\begin{aligned} V^{\gamma}(T) &= \int_0^T \pi_1(\gamma,0)\, e^{-rt}dt + \int_T^{\infty} \pi_1(\gamma,\gamma)\, e^{-rt}dt - \int_0^{\infty} \pi_1(0,0)\, e^{-rt}dt \\ &= \int_0^T \frac{1}{16}\tau(9-5\alpha)\, e^{-rt}dt + \int_T^{\infty} \frac{1}{4}\tau e^{-rt}dt - \int_0^{\infty} \frac{1}{4}\tau(2-\alpha)\, e^{-rt}dt \\ &= \frac{1}{16}\tau(9-5\alpha)\frac{1}{r}\left(1-e^{-rT}\right) + \frac{1}{4}\tau\frac{1}{r}e^{-rT} - \frac{1}{4}\tau(2-\alpha)\frac{1}{r} \\ &= \frac{1}{16}\tau\left(1-5e^{-rT}\right)\frac{1-\alpha}{r}. \end{aligned}$$

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

Similar to the usual product or process innovation, γ 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 γ if T is sufficiently large and k sufficiently small. However, here since $V^{\gamma}(T) < 0$ when $T < \frac{\ln 5}{r}$, γ 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

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

Thus, $V^{\gamma}(T)$ approaches $\pi_1(\gamma,\gamma) - \pi_1(0,0)$ as T tends to 0. 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

$$\begin{aligned} \delta &= [\pi_1(\gamma,0) - \pi_1(0,0)] + [\pi_1(\gamma,\gamma) - \pi_1(\gamma,0)] \\ &= \pi_1(\gamma,\gamma) - \pi_1(0,0). \\ &= \frac{1}{2}\{\pi_1(\gamma,\gamma) + \pi_2(\gamma,\gamma) - [\pi_1(0,0) + \pi_2(0,0)]\} \\ &= \frac{1}{2}\Delta, \end{aligned}$$

where Δ is the change in the instantaneous industry profit if γ were to be adopted simultaneously by all firms.

If γ 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 Δ to be positive. But here we have the opposite:

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

or $\delta < 0$ and $\Delta < 0$. This suggests that the simultaneous adoption of a marketing innovation by all firms can reduce industry profits.

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 γ by the rival, the extracting-surplus effect dominates and thus the innovating firm benefits from γ. When γ 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.[8]

Our analysis here is closely related to the literature on price discrimination by competing firms. Consumer targeting and price discrimination are often equilibrium strategies of competing firms, and such practices can sometimes 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).[9] However, by modeling the strategic interaction between competitors as a dynamic process, our analysis yields quite different insights. In our model the adoption of γ by both firms also leads to lower industry profits, but γ can occur in equilibrium only if firm 1's profit is higher from introducing it. 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.[10] Furthermore, when T approaches zero, or when firm 2

[8]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 γ by all firms can increase industry profits.

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

[10]For firms with asymmetric market shares or costs, it is possible that a firm can benefit from targeted

can react very quickly to the introduction of γ by firm 1, instead of a Prisoner's' Dilemma outcome, γ does not occur in equilibrium.[11]

An examination of equation (7) reveals the following:

Corollary 1 *The value of γ to the innovating firm is higher if τ is higher or if α is lower.*

Since τ is unchanged with or without γ, and since the equilibrium prices in all instantaneous games are increasing functions of τ, we can consider τ as a measure of the competitiveness of the market, with a higher τ suggesting lower intensity in competition. Corollary 1 then suggests that the value of γ is higher when the market is less competitive.[12] 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 γ. As we shall see shortly, however, in general the relationship between the value of innovation and competitiveness 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, σ, the development of a new trading method that reduces the coefficient of consumer transaction cost from τ to $\mu \in (0, \tau)$, when the consumer trades with the firm that uses the new trading method.[13] Thus, σ can be a new trading technology (such as Amazon.com's "one-click" online ordering process), a new selling format (such as selling with a fixed price instead of through negotiations), or a

pricing. See, for example, 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.

[11] For our purpose we have assumed that firm 2 cannot have γ without the innovation of firm 1. As we shall discuss later, our result may also hold in a more general model where both firms have opportunities to innovate.

[12] Since the average prices in all subgames decrease in α, we may also consider α as a measure of competitiveness, and similarly the incentive for γ is higher when the market is less competitive.

[13] In the literature, τ is also interpreted as a preference parameter. With this alternative interpretation, σ can be viewed as a new technology that reduces the intensity of differences in consumers' preferences towards firm 1's product.

new selling channel (such as an internet store).[14] The possible states of innovation are now $(\phi_1, \phi_2) \in \{(0,0), (\sigma,0), (\sigma,\sigma)\}$, representing the states of σ by neither firm, of σ by firm 1 only, and of σ by both firms. Everything else is the same as in the previous section.

For the instantaneous games where only firm 1 implements σ, consider first the competition for consumers in group A. The equilibrium prices of firms 1 and 2 will be

$$\begin{aligned} p_1^A(x \mid \sigma, 0) &= max\{c, c + \tau(1-x) - \mu x\}, \\ p_2^A(x \mid \sigma, 0) &= max\{c, c + \mu x - \tau(1-x)\}, \end{aligned}$$

and the marginal consumer $\hat{x}$ is determined by

$$\tau(1-\hat{x}) - \mu\hat{x} = 0,$$

or

$$\hat{x} = \frac{\tau}{\tau + \mu}.$$

The equilibrium instantaneous profits of firms 1 and 2 from consumer group A thus are:

$$\begin{aligned} \pi_1^A(\sigma, 0) &= \alpha \int_0^{\frac{\tau}{\tau+\mu}} (\tau(1-x) - \mu x)\, dx = \frac{1}{2}\alpha\frac{\tau^2}{\tau+\mu}, \\ \pi_2^A(\sigma, 0) &= \alpha \int_{\frac{\tau}{\tau+\mu}}^1 (\mu x - \tau(1-x))\, dx = \frac{1}{2}\alpha\frac{\mu^2}{\tau+\mu}. \end{aligned}$$

For consumers in group B, the marginal consumer is determined by

$$p_1 + \mu\hat{x} = p_2 + \tau(1-\hat{x})$$

or

$$\hat{x} = \frac{-p_1 + p_2 + \tau}{\mu + \tau}.$$

The equilibrium prices of firms 1 and 2, $p_1^B(\sigma, 0)$ and $p_2^B(\sigma, 0)$, satisfy the first-order conditions:

$$\begin{aligned} p_2 - p_1 + \tau - p_1 + c &= 0, \\ p_1 - p_2 + \mu - p_2 + c &= 0. \end{aligned}$$

[14] Notice that a reduction in τ affects different consumers differently. Our formulation thus ensures that σ differs from a product innovation that increases consumers' valuation V and from a process innovation that reduces production cost c.

Thus

$$p_1^B(\sigma,0) = c+\frac{1}{3}(2\tau+\mu),$$
$$p_2^B(\sigma,0) = c+\frac{1}{3}(\tau+2\mu),$$

and

$$\hat{x}=\frac{\frac{1}{3}(\tau+2\tau_1)-\frac{1}{3}(2\tau+\tau_1)+\tau}{\tau_1+\tau}=\frac{1}{3}\frac{2\tau+\mu}{\mu+\tau}.$$

The equilibrium instantaneous profits of firms 1 and 2 from consumer group B thus are:

$$\pi_1^B(\sigma,0) = (1-\alpha)\frac{1}{3}(2\tau+\mu)\frac{1}{3}\frac{2\tau+\mu}{\mu+\tau}=\frac{1}{9}(1-\alpha)\frac{(2\tau+\mu)^2}{\mu+\tau},$$
$$\pi_2^B(\sigma,0) = (1-\alpha)\frac{1}{3}(\tau+2\mu)\left(1-\frac{1}{3}\frac{2\tau+\mu}{\mu+\tau}\right)=\frac{1}{9}(1-\alpha)\frac{(\tau+2\mu)^2}{\mu+\tau}.$$

Adding profits from the two groups together, we obtain the equilibrium profits of firms 1 and 2 in state $(\sigma,0)$ as:

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

Next, for all possible subgames where both firms have implemented σ, the analysis is again the same as in the previous section and thus

$$\pi_i(\sigma,\sigma)=\frac{1}{4}\mu(2-\alpha).$$

We have:

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

$$V^\sigma(T)=\begin{cases}\frac{1}{36r}(\tau-\mu)\frac{11\alpha\tau+4\alpha\mu-2\tau-4\mu}{\tau+\mu} & if \quad \alpha<\frac{4\tau+2\mu}{11\tau+4\mu}\\ \frac{1}{36r}(\tau-\mu)\frac{11\alpha\tau+4\alpha\mu-2\tau-4\mu-e^{-rT}(16\tau+14\mu-5\alpha\mu+2\alpha\tau)}{\tau+\mu} & if \quad \alpha\geq\frac{4\tau+2\mu}{11\tau+4\mu}\end{cases},$$

where (i) if $\alpha<\frac{2\tau+4\mu}{11\tau+4\mu}$, $V^\sigma(T)<0$;

(ii) if $\frac{2\tau+4\mu}{11\tau+4\mu}<\alpha<\frac{4\tau+2\mu}{11\tau+4\mu}$, $V^\sigma(T)>0$;

(iii) if $\alpha \geq \frac{4\tau+2\mu}{11\tau+4\mu}$, $V^{\sigma}(T) > 0$ *if* $T > \frac{1}{r}\ln\left(\frac{2\alpha\tau+16\tau+14\mu-5\alpha\mu}{11\alpha\tau+4\alpha\mu-2\tau-4\mu}\right) > 0$ *and* $V^{\sigma}(T) < 0$ *otherwise.*

Proof. Since

$$\begin{aligned} & \pi_2(\sigma,\sigma) - \pi_2(\sigma,0) \\ = \ & \frac{1}{4}\mu(2-\alpha) - \frac{1}{18}\frac{\alpha\mu^2 - 2\alpha\tau^2 - 8\alpha\tau\mu + 2(\tau+2\mu)^2}{\tau+\mu} \\ = \ & \frac{1}{36}(\tau-\mu)\frac{4\tau\alpha - 4\tau - 2\mu + 11\alpha\mu}{\tau+\mu} \gtreqless 0 \text{ if } \alpha \gtreqless \frac{4\tau+2\mu}{11\tau+4\mu}, \end{aligned}$$

firm 2 will imitate σ if and only if $\alpha \geq \frac{4\tau+2\mu}{11\tau+4\mu}$. Furthermore,

$$\begin{aligned} & \pi_1(\sigma,0) - \pi_1(0,0) \\ = \ & \frac{1}{18}\frac{\alpha\tau^2 - 8\alpha\tau\mu - 2\alpha\mu^2 + 2(2\tau+\mu)^2}{\tau+\mu} - \frac{1}{4}\tau(2-\alpha) \\ = \ & \frac{1}{36}(\tau-\mu)\frac{11\alpha\tau + 4\alpha\mu - 2\tau - 4\mu}{\tau+\mu} \gtreqless 0 \text{ if } \alpha \gtreqless \frac{2\tau+4\mu}{11\tau+4\mu}. \end{aligned}$$

Therefore, If $\alpha < \frac{2\tau+4\mu}{11\tau+4\mu}$, firm 2 will not imitate if σ is introduced, and thus

$$\begin{aligned} V^{\sigma}(T) &= [\pi_1(\sigma,0) - \pi_1(0,0)]\frac{1}{r} \\ &= \frac{1}{36r}(\tau-\mu)\frac{11\alpha\tau + 4\alpha\mu - 2\tau - 4\mu}{\tau+\mu} < 0. \end{aligned}$$

If

$$\frac{2\tau+4\mu}{11\tau+4\mu} < \alpha < \frac{4\tau+2\mu}{11\tau+4\mu},$$

again firm 2 will not imitate if σ is introduced,

$$\begin{aligned} V^{\sigma}(T) &= [\pi_1(\sigma,0) - \pi_1(0,0)]\frac{1}{r} \\ &= \frac{1}{36r}(\tau-\mu)\frac{11\alpha\tau + 4\alpha\mu - 2\tau - 4\mu}{\tau+\mu} > 0. \end{aligned}$$

If $\alpha \geq \frac{4\tau+2\mu}{11\tau+4\mu}$, $\pi_2(\sigma,\sigma) - \pi_2(\sigma,0) > 0$, and hence firm 2 will imitate if σ is introduced. Thus,

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

$$
\begin{aligned}
&= \int_0^T \frac{1}{18}\frac{\alpha\tau^2 - 8\alpha\tau\mu - 2\alpha\mu^2 + 2\left(2\tau+\mu\right)^2}{\tau+\mu} e^{-rt}dt + \int_T^\infty \frac{1}{4}\mu\left(2-\alpha\right)e^{-rt}dt \\
&\quad - \int_0^\infty \frac{1}{4}\tau\left(2-\alpha\right)e^{-rt}dt \\
&= \frac{1}{36}\left(\tau-\mu\right)\frac{11\alpha\tau - 2\tau - 4\mu + 4\alpha\mu - e^{-rT}\left(2\alpha\tau + 16\tau + 14\mu - 5\alpha\mu\right)}{\left(\tau+\mu\right)r} \\
&= \frac{1}{36r}\left(\tau-\mu\right)\frac{\alpha\left(11\tau + 4\mu + e^{-rT}\left(5\mu - 2\tau\right)\right) - e^{-rT}\left(16\tau + 14\mu\right) - 2\tau - 4\mu}{\tau+\mu} \\
&\gtreqless 0 \text{ if } T \gtreqless \frac{1}{r}\ln\left(\frac{2\alpha\tau + 16\tau + 14\mu - 5\alpha\mu}{11\alpha\tau + 4\alpha\mu - 2\tau - 4\mu}\right),
\end{aligned}
$$

and $\frac{1}{r}\ln\left(\frac{2\alpha\tau+16\tau+14\mu-5\alpha\mu}{11\alpha\tau+4\alpha\mu-2\tau-4\mu}\right) > 0$ since $11\alpha\tau + 4\alpha\mu - 2\tau - 4\mu > 0$ and

$$
2\alpha\tau + 16\tau + 14\mu - 5\alpha\mu - \left(11\alpha\tau + 4\alpha\mu - 2\tau - 4\mu\right) = 9\left(\tau+\mu\right)\left(2-\alpha\right) > 0.
$$

■

We notice that $V^\sigma\left(T\right)$ is independent of T when $\alpha < \frac{4\tau+2\mu}{11\tau+4\mu}$ and is otherwise increasing in T. We thus immediately have the following:

Remark 1 *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 $V^\gamma\left(T\right) < 0$ if $T < \frac{\ln 5}{r}$, 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 $V^\sigma\left(T\right) < 0$ for any T further highlights the potential difference between marketing innovation and product or process innovations. To understand this difference, we can again write

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

Same as for $V^\gamma\left(T\right)$, we can decompose the terms affecting $V^\sigma\left(T\right)$ into invention effect $\pi_1(\sigma,0) - \pi_1\left(0,0\right)$ and 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 γ, or

$$
\pi_1\left(\gamma,0\right) - \pi_1\left(0,0\right) = \frac{1}{16}\tau\left(9-5\alpha\right) - \frac{1}{4}\tau\left(2-\alpha\right) = \frac{1}{16}\tau\left(1-\alpha\right) > 0,
$$

it can be negative for σ here since

$$\begin{aligned}&\pi_1(\sigma,0)-\pi_1(0,0)\\ =\ &\frac{1}{36}(\tau-\mu)\frac{-2\tau+11\alpha\tau-4\mu+4\alpha\mu}{\tau+\mu}<0 \text{ if } \alpha<\frac{2\tau+4\mu}{11\tau+4\mu},\end{aligned}$$

in which case $V^{\sigma}(T)<0$ for any T.

Same as γ, innovation σ increases the innovating firm's ability to extract consumer surplus but causes the competitive response of the rival with lower prices. But for σ the negative competitive-response effect can dominate the positive extracting-surplus effect even before the imitation of σ, which explains why for σ even the invention effect can be negative.

We now return to the relationship between competition and the incentives for marketing innovation. Since α is unchanged with or without σ, here it is natural to consider α as a measure of competitiveness of the market, with a higher α suggesting a more competitive market. From Proposition 2, when $V^{\sigma}(T)>0$, we have

$$\frac{\partial V^{\sigma}(T)}{\partial\alpha}=\begin{cases}\frac{1}{36r}(\tau-\mu)\frac{11\tau+4\mu}{\tau+\mu} & if \quad \alpha<\frac{4\tau+2\mu}{11\tau+4\mu}\\ \frac{1}{36r}(\tau-\mu)\frac{11\tau+4\mu+(5\mu-2\tau)e^{-rT}}{\tau+\mu} & if \quad \alpha>\frac{4\tau+2\mu}{11\tau+4\mu}\end{cases}.$$

Furthermore, $V^{\sigma}(T)$ approaches its highest level just before a discontinuous reduction at $\alpha=\frac{4\tau+2\mu}{11\tau+4\mu}$. Therefore, locally $V^{\sigma}(T)$ is higher when competition is more fierce, but globally it tends to be the highest in some intermediate level of competitiveness. To see the reason behind this outcome, we make two observations. First, notice that

$$p_2^A(x\mid 0,0)=max\{c,c+\tau(2x-1)\}=p_2^A(x\mid\sigma,0).$$

That is, firm 2's equilibrium prices for consumers in Group A are the same in states $(0,0)$ and $(\sigma,0)$. Thus, when α is higher (the portion of group A consumers is higher), the rival's competitive response is less important, and hence the innovating firm benefits more from the extracting-surplus effect, resulting in a higher $V^{\sigma}(T)$. This explains why $V^{\sigma}(T)$ increases in α locally. Second, since firm 2 will imitate σ if and only if $\alpha\geq\frac{4\tau+2\mu}{11\tau+4\mu}$, the negative imitation effect kicks in at $\alpha=\frac{4\tau+2\mu}{11\tau+4\mu}$, which explains the downward drop of $V^{\sigma}(T)$ at $\alpha=\frac{4\tau+2\mu}{11\tau+4\mu}$ and why $V^{\sigma}(T)$ approaches the highest for some intermediate value of α.[15]

[15] For a given μ, a change in the value of τ also changes the relative magnitude of the innovation σ itself.

Recall that for marketing innovation γ, $V^{\gamma}(T)$ is higher when the intensity of competition is lower. We thus have:

Remark 2 *Increased competition reduces the incentive for marketing innovation γ but may increase the incentive for marketing innovation σ.*

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, γ. Since social surplus is the same in states $(0,0)$ and (γ,γ) 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 γ. But this result is easily anticipated given the fact that in our model total output is fixed. Marketing innovation γ 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 γ 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 γ.[16] Nevertheless, as long as consumer demand is sufficiently inelastic, our result would be valid.

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

This makes it less clear how to interpret the relationship between V^{σ} and competition using τ as a measure of competitiveness here. One can verify that for the parameter values such that $V^{\sigma}(T) \geq 0$, $V^{\sigma}(T)$ increases in τ.

[16] 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.

value of σ would be

$$\begin{aligned}\bar{S} &= \int_0^T \left[\int_0^{\frac{1}{2}} (\tau-\mu)\, xdx + \int_{\frac{\mu}{\tau+\mu}}^{\frac{1}{2}} \tau xdx - \int_{\frac{1}{2}}^{\frac{\tau}{\tau+\mu}} \mu xdx\right] e^{-rt}dt + \int_T^{\infty} 2\int_0^{\frac{1}{2}} (\tau-\mu)\, xdxe^{-rt}dt \\ &= \int_0^T \frac{1}{4}\tau\frac{\tau-\mu}{\tau+\mu}e^{-rt}dt + \int_T^{\infty} \frac{1}{4}(\tau-\mu)\, e^{-rt}dt = \frac{1}{4}\tau(\tau-\mu)\frac{1-e^{-rT}}{r(\tau+\mu)} + \frac{e^{-rT}}{4r}(\tau-\mu) \\ &= \frac{1}{4}(\tau-\mu)\frac{\tau+e^{-rT}\mu}{r(\tau+\mu)}.\end{aligned}$$

From Proposition 2, we have:

$$V^{\sigma}(T) \leq \frac{1}{36r}(\tau-\mu)\frac{-2\tau+11\alpha\tau-4\mu+4\alpha\mu}{\tau+\mu},$$

and thus

$$\begin{aligned}\bar{S}-V^{\sigma}(T) &\geq \frac{1}{4}(\tau-\mu)\frac{\tau+e^{-rT}\mu}{r(\tau+\mu)} - \frac{1}{36r}(\tau-\mu)\frac{-2\tau+11\alpha\tau-4\mu+4\alpha\mu}{\tau+\mu} \\ &= \frac{1}{36}(\tau-\mu)\frac{11\tau(1-\alpha)+9e^{-rT}\mu+4\mu(1-\alpha)}{r(\tau+\mu)} > 0.\end{aligned}$$

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

$$\underline{S} = \begin{cases} \int_0^{\infty} \frac{1}{4}\tau\frac{\tau-\mu}{\tau+\mu}e^{-rt}dt = \frac{1}{4}\frac{1}{r}\tau\frac{\tau-\mu}{\tau+\mu} & if \quad \alpha < \frac{4\tau+2\mu}{11\tau+4\mu} \\ \int_0^{T} \frac{1}{4}\tau\frac{\tau-\mu}{\tau+\mu}e^{-rt}dt + \int_T^{\infty} \frac{1}{4}(\tau-\mu)\, e^{-rt}dt = \frac{1}{4}(\tau-\mu)\frac{\tau+e^{-rT}\mu}{r(\tau+\mu)} & if \quad \alpha \geq \frac{4\tau+2\mu}{11\tau+4\mu} \end{cases}.$$

We have

$$\begin{aligned}\underline{S}-V^{\sigma}(T) &\geq \begin{cases} \frac{1}{4}\frac{1}{r}\tau\frac{\tau-\mu}{\tau+\mu} - \frac{1}{36r}(\tau-\mu)\frac{11\alpha\tau+4\alpha\mu-2\tau-4\mu}{\tau+\mu} & if \quad \alpha < \frac{4\tau+2\mu}{11\tau+4\mu} \\ \frac{1}{4}(\tau-\mu)\frac{\tau+e^{-rT}\mu}{r(\tau+\mu)} - \frac{1}{36r}(\tau-\mu)\frac{-2\tau+11\alpha\tau-4\mu+4\alpha\mu}{\tau+\mu} & if \quad \alpha \geq \frac{4\tau+2\mu}{11\tau+4\mu} \end{cases} \\ &= \begin{cases} \frac{1}{36}(\tau-\mu)(11\tau+4\mu)\frac{1-\alpha}{r(\tau+\mu)} > 0 & if \quad \alpha < \frac{4\tau+2\mu}{11\tau+4\mu} \\ \frac{1}{36}(\tau-\mu)\frac{11\tau(1-\alpha)+9e^{-rT}\mu+4\mu(1-\alpha)}{r(\tau+\mu)} > 0 & if \quad \alpha \geq \frac{4\tau+2\mu}{11\tau+4\mu} \end{cases},\end{aligned}$$

where we have used the fact that firm 2 will not imitate if $\alpha < \frac{4\tau+2\mu}{11\tau+4\mu}$ and will otherwise imitate with delay T.

Therefore, for σ 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.

To summarize, we have:

Proposition 3 *Relative to the socially optimal level, the private incentive is too high for* γ *but too low for* σ.

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 can shed light on this issue. For certain marketing innovation, such as γ 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 σ here, while patent protection may increase private innovating incentives in some situations, it is also possible that such protection has no effect on these incentives (since $V^{\sigma}(T)$ is sometimes independent of T).

6. Multiple Firms and the Effects of Market Structure

We now extend our analysis to a setting with many firms, using a version of the spokes model developed in Chen and Riordan (2003). Suppose that there are $n \geq 2$ varieties of a product, and variety i ($i = 1, ..., n$) is associated with a line of length $\frac{1}{2}$, l_i. The two ends of l_i are called origins and terminals, respectively. Variety i is produced at the origin of l_i, and the lines are so arranged that all the terminals meet at one point, which is the center. This forms a network of lines connecting competing varieties, and a consumer can reach and purchase a variety only by traveling to it on the lines. The travel cost is the transaction cost. Consumers are uniformly distributed on the network of spokes. The location of a consumer is fully characterized by a vector (l_i, x_i), which means that the consumer is on l_i with a distance of x_i to firm i.[17] Since all the other firms are symmetric, the distance from consumer (l_i, x_i) to any variety j, $j \neq i$, is $\frac{1}{2} - x_i + \frac{1}{2} = 1 - x_i$. Obviously, the duopoly model is a special case of the spokes model with $n = 2$.

To allow for asymmetry in firm sizes, we assume that varieties $1, ..., m$ $(1 \leq m < n)$, are produced by firm 1, while the rest $n - m$ firms each produces one variety. The total number of firms is thus $1 + n - m$. The location of each consumer is assumed to be known by all firms (corresponding to the case of $\alpha = 1$ in the previous section). Assume that at time 0, one of the firms can introduce marketing innovation σ that reduces the consumers' unit transaction cost from τ to $\mu \in (0, \tau)$.[18]

First, in every instantaneous game without σ, or in states $(0, ..., 0)$, each firm sells to the consumers on its spoke with equilibrium price

$$p_i\left(l_i, x_i \mid 0, ..., 0\right) = \max\left\{c, c + \tau\left(1 - 2x_i\right)\right\}, \qquad i = 1, ..., n.$$

The instantaneous profits for firm 1 and each of the other firms are:

$$\pi_1\left(0, ..., 0\right) = m \int_0^{\frac{1}{2}} \frac{2}{n}\tau\left(1 - 2x_i\right) dx_i = \frac{1}{2} m \frac{\tau}{n}, \tag{9}$$

$$\pi_j\left(0, ..., 0\right) = \int_0^{\frac{1}{2}} \frac{2}{n}\tau\left(1 - 2x_j\right) dx_j = \frac{1}{2}\frac{\tau}{n}, \qquad j = 2, ..., n - m + 1. \tag{10}$$

Next, in every instantaneous game with σ by firm 1 alone, or in states $(\sigma, 0, ..., 0)$, firm 1's equilibrium prices become

$$\begin{aligned} p_1\left(l_j, x_j \mid \sigma, 0..., 0\right) &= max\left\{c, c + \tau\left(1 - 2x_j\right) + (\tau - \mu)x_j\right\}, \qquad j = 1, ..., m. \\ p_1\left(l_j, x_j \mid \sigma, 0..., 0\right) &= max\left\{c, c + \tau x_j - \mu(1 - x_j)\right\}, \qquad j = m + 1, ..., n. \end{aligned}$$

And for firm $i = 2, ..., n - m + 1$, the equilibrium prices are

$$p_i\left(l_j, x_j \mid \sigma, ..., 0\right) = \begin{cases} max\left\{c, c + \mu(1 - x_i) - \tau x_i\right\} & if \quad j = i \\ c + \tau\left(1 - x_j\right) & if \quad j \neq i \end{cases}.$$

[17] For the consumer located at the center, we shall denote her by $\left(l_1, \frac{1}{2}\right)$.

[18] Notice that we now need to consider the incentives of firm 1 and of any other firm separately, while in the basic model there is no difference to assign firm 1 or firm 2 to be the potential innovator.

The instantaneous profits of firm 1 and each of the other firms are:

$$\begin{aligned}\pi_1(\sigma,0,...,0) &= m\frac{2}{n}\int_0^{\frac{1}{2}}(\tau(1-2x_1)+(\tau-\mu)x_1)\,dx_1+(n-m)\int_{\frac{\mu}{\tau+\mu}}^{\frac{1}{2}}\frac{2}{n}(\tau x_j-\mu(1-x_j))\,dx_j \\ &= \frac{1}{4}m\frac{3\tau-\mu}{n}+\frac{1}{4}(n-m)\frac{(\tau-\mu)^2}{(\tau+\mu)n},\end{aligned}$$

$$\pi_j(\sigma,0,...,0)=\int_0^{\frac{\mu}{\tau+\mu}}\frac{2}{n}(\mu(1-x_j)-\tau x_j)\,dx_j=\frac{\mu^2}{(\tau+\mu)n},\qquad j=2,...,n-m+1.$$

Similarly, in every instantaneous game with σ by firm j alone, $j=2,...,n-m+1$, or in states $(0,...,\sigma,...,0)$, the instantaneous profits of firm 1, firm j, and firm $i\neq j\neq 1$ are respectively:

$$\begin{aligned}\pi_1(0,...,\sigma,...,0) &= m\frac{\mu^2}{(\tau+\mu)n}, \\ \pi_j(0,...,\sigma,...,0) &= \frac{1}{4}\frac{3\tau-\mu}{n}+\frac{1}{4}(n-1)\frac{(\tau-\mu)^2}{(\tau+\mu)n}, \\ \pi_i(0,...,\sigma,...,0) &= \frac{\mu^2}{(\tau+\mu)n},\ i\neq j\neq 1.\end{aligned}$$

Next, if σ has been introduced (adopted) by h firms, $h=1,...n-m+1$, by also adopting σ, the instantaneous profits of firm 1 and each of the other firms are:

$$\begin{aligned}\pi_1(\sigma,...\sigma,...) &= \frac{1}{2}m\frac{\mu}{n}, \\ \pi_j(...\sigma,...\sigma,...) &= \frac{1}{2}\frac{\mu}{n},\qquad j=2,...,n-m+1.\end{aligned}$$

We have:

Proposition 4 *For any $m\geq 1$, the values of innovation σ for firm 1 and for firm j, $j=2,...,n-m+1$, are respectively:*

$$V_1(T)=\frac{1}{4}(\tau-\mu)\frac{2m\left(-\tau e^{-Tr}+\mu-2e^{-Tr}\mu\right)+n\left(1-e^{-Tr}\right)(\tau-\mu)}{(\tau+\mu)nr},$$

$$V_j(T)=\frac{1}{4}(\tau-\mu)\frac{2\left(-\tau e^{-Tr}+\mu-2e^{-Tr}\mu\right)+n\left(1-e^{-Tr}\right)(\tau-\mu)}{(\tau+\mu)nr}.$$

Furthermore, when $m>1$ and for $j\neq 1$,

$$V_1(T)\gtreqless V_j(T)\ \text{if and only if}\ T\gtreqless\frac{1}{r}\ln\frac{\tau+2\mu}{\mu}.$$

Proof. Since

$$\frac{1}{2}\frac{\mu}{n} - \frac{\mu^2}{(\tau+\mu)\,n} = \frac{1}{2}\mu\frac{\tau-\mu}{(\tau+\mu)\,n} > 0,$$

innovation σ will be imitated by all firms in any equilibrium. The value of innovation to firm 1 is thus:

$$\begin{aligned} V_1(T) &= \int_0^T \left(\frac{1}{4}m\frac{3\tau-\mu}{n} + \frac{1}{4}(n-m)\frac{(\tau-\mu)^2}{(\tau+\mu)\,n}\right)e^{-rt}dt + \int_T^\infty \frac{1}{2}m\frac{\mu}{n}e^{-rt}dt - \int_0^\infty \frac{m\tau}{2n}e^{-rt}dt \\ &= -\frac{1}{4}(\tau-\mu)\frac{2\tau me^{-Tr} - n\tau + \tau ne^{-Tr} - n\mu e^{-Tr} - 2m\mu + 4\mu me^{-Tr} + n\mu}{(\tau+\mu)\,nr} \\ &= \frac{1}{4}(\tau-\mu)\frac{2m\left(-\tau e^{-Tr} + \mu - 2e^{-Tr}\mu\right) + n\left(1-e^{-Tr}\right)(\tau-\mu)}{(\tau+\mu)\,nr}, \end{aligned}$$

and the value of innovation to firm j, $j = 2, ..., n-m+1$, is

$$V_j(T) = \frac{1}{4}(\tau-\mu)\frac{2\left(-\tau e^{-Tr} + \mu - 2e^{-Tr}\mu\right) + n\left(1-e^{-Tr}\right)(\tau-\mu)}{(\tau+\mu)\,nr}.$$

Thus, when $m > 1$ and for $j \neq 1$,

$$V_1(T) \gtreqless V_j(T)$$

if and only if

$$-\tau e^{-Tr} + \mu - 2e^{-Tr}\mu \gtreqless 0,$$

or

$$T \gtreqless \frac{1}{r}\ln\frac{\tau+2\mu}{\mu}.$$

■

Proposition 3 offers insights on two issues concerning the relationship between market structure and incentives for marketing innovation. First, we may ask how market concentration affects the average per-firm value from the innovation (or the incentive for marketing innovation by an average firm in the market). Notice that market concentration is higher with higher m for any given n. But since for $j \neq 1$, $V_1(T) > V_j(T)$ and $V_1(T)$ increases in m if and only if $T > \frac{1}{r}\ln\frac{\tau+2\mu}{\mu}$, while $V_j(T)$ is independent of m, we conclude:

Corollary 2 *When imitation is sufficiently difficult ($T > \frac{1}{r}\ln\frac{\tau+2\mu}{\mu}$), a more concentrated market will have higher incentive for marketing innovation; and otherwise the opposite is true.*

Second, we can address the issue of whether a large firm (an incumbent) or a small firm (an entrant) has higher incentive for marketing innovation. Suppose that the large firm (incumbent) produces $n - 1 > 1$ varieties, and the small firm (entrant) produces the n^{th} variety, we immediately have the following:

Corollary 3 *A large firm (an incumbent) has higher incentive for marketing innovation than a small firm (an entrant) if and only if imitation is sufficiently difficult ($T > \frac{1}{r} \ln \frac{\tau+2\mu}{\mu}$).*

While our analysis is conducted in a specific setting, we believe that the basic insight here is valid more generally. A large and a small firm face similar trade-offs in introducing a marketing innovation. The innovator benefits from the positive invention effect and is harmed by the imitation effect. While the large firm benefits more from the invention effect, it also loses more from the imitation effect. The increase in the level of difficulty to imitate, however, benefits the large firm more by postponing the imitation effect without reducing the invention effect. This suggests that for marketing innovations that are relatively easy to imitate, they are more likely to be introduced by small firms/new entrants and in less concentrated markets, while for marketing innovations that are more difficult to imitate, they are more likely to be introduced by large firms/incumbents and in more concentrated markets.

7. 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: γ, which allows a firm to acquire consumer information (target consumers) more effectively; and σ, which reduces consumer transaction costs. Similar to those for product or process innovation, a firm's incentive for marketing innovation depends on an immediate invention effect and a (negative) delayed imitation effect. Unlike for product or process innovation, however, for a marketing innovation the undiscounted sum of the invention and imitation effects can often be negative, and it is possible that even the invention effect itself is negative. The value of marketing innovation is positive only if both the invention effect is positive and there is a sufficient delay before imitation. A firm's incentive for marketing innovation also depends on market structure and the nature of competition. Within a duopoly market structure, an increase in competition intensity reduces the value of the marketing innovation to acquire consumer information but may increase the value of the marketing innovation to reduce consumer transaction cost. Holding constant the nature of competition but allowing multiple firms, a more concentrated market or a larger firm has higher incentives for marketing innovation when imitation is sufficiently difficult, and otherwise the opposite is true. We also find that, relative to the socially optimal level, the private incentive for the marketing innovation to acquire consumer information is too high while that to reduce consumer transaction cost is too low.

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 model, l_1 and l_2, originating from firm 1 towards its left and from firm 2 towards its right, respectively, and l_i is longer than 1. A mass of β (> 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 τx_i to purchase from firm i. Then, without γ firm i will set $p_i = c + \tau$ to consumers on l_i and not all consumers on l_i will purchase. And with γ, 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 γ. With this modification of our model, γ 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 easy to see that this will increase $V^{\gamma}(T)$, and it becomes possible (when β is large) that the instantaneous industry profit will increase (the sum of the invention and imitation effects is positive) if γ were to be adopted simultaneously by both firms. The same can be true for σ. Furthermore, in this modified model the private incentive for γ could be too low, since the innovation of γ has a positive externality through the expansion of output on l_2 when firm 2 imitates γ, 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 always in direct competition, we focus on 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.

For the purpose of this paper we have assumed that only one firm has the opportunity to conduct marketing innovation. It is natural to extend the analysis to a setting where all firms have opportunities to innovate and may compete in innovation. One possible way such an analysis could proceed is as follows: Suppose that everything is the same as in Sections 2 and 3, except that firm 2 also has the opportunity to introduce γ 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 γ, whether it has the opportunity to do so is its private information; and that after one firm introduces γ, another firm can imitate the innovation with a delay time $\tilde{T} \leq T$. Then, I conjecture that the following is true in equilibrium: If $\tilde{T}$ is sufficiently large and k sufficiently small, each firm will introduce γ when it has the opportunity to do so. If $\tilde{T}$ 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 γ, 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 γ when it has the opportunity to do so (the non-collusive outcome). Thus, it appears that the equilibrium outcome in Section 3, where the firm with the innovating ability will introduce γ when T is sufficiently large and k sufficiently small, and where γ is not introduced when T is small, can also be an equilibrium outcome in this extended model.

There are other directions to extend our analysis. For instance, 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. It would also be interesting to consider other possible forms of marketing innovation. 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 would seem warranted.

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