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The Effects of Imbalanced Competition On Demonstration Strategies

by

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The Effects of Imbalanced Competition on Demonstration Strategies[1]

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The Effects of Imbalanced Competition on Demonstration Strategies

Abstract

This paper analyzes the effect of competition on product demonstration decisions. Pre-purchase product demonstration enables marketers to differentiate products that are ex-post differentiated but are judged according to perceived fit, rather than actual fit, due to pre-purchase consumer uncertainty. Imbalanced competition accompanied by fit uncertainty motivates the follower to offer demonstrations to avoid a price war. This paper explores the conditions that lead the leader to retaliate. In addition to effects on quantity, competition may increase the quality of demonstrations offered by the leader.

We analyze a business case, showing that competition may increase the demonstration intensity and that the leading manufacturer's response to changes in competition is stronger than the responses of the followers.

Our research has the potential to aid mangers in formulating demonstration strategies and in responding to competitors' demonstration efforts.

Keywords: Imbalanced competition; product demonstration, differentiation, test-drive, price war.

The Effects of Imbalanced Competition on Demonstration Strategies

1. Introduction

Demonstrations are defined as "the act of proving or illustrating by examples" (*Webster's Dictionary*). Naturally, demonstrations are most powerful when they prove an assertion that could not be supported otherwise. Examples are unbreakable glass (e.g., Corning glass[2]; 3M); laundry detergent that removes a stain from a white shirt or that preserves the clothes' original colors (P&G commercial for Bold[3]); dishwashing detergent that makes dishes spotless (Dreft 1937 film commercial[4]); and an unfamiliar auto manufacturer that challenges a better-known brand (Lexus vs. Mercedes in the 1980s). Demonstrations constitute a continuum of efforts at illustration, with TV and tradeshow demonstrations at the low end and pre-purchase product trials (samples of frequently purchased products and demonstrations on durable products) that allow personal experience with a potential product at the high end.

The inherent differences between durable and frequently purchased products affect the nature of pre-purchase trials, i.e., frequently purchased products are demonstrated through product samples, and durable products are offered in constrained pre-purchase trials. Product samples, which are usually contained in smaller packages, allow consumers to directly experience a product on their own time and in their own space without paying for the product. As Kempf and Smith (1988, P. 326) note, "trials are unique from advertisement (and other forms of indirect experience) because they provide the consumer with direct sensory contact with the product." Post-sample experience is more closely related to brand belief than advertising (Fazio & Zanna, 1978). Sampling crafts stronger, more accessible perceptions that are more likely to be activated in consequence judgment than attitudes formed through indirect experience (Fazio, Chen, McDonel & Sherman. 1982; Smith & Swinyard 1983; Fazio, Powell, & Williams, 1989). The strong impact of sampling on adoption has led scholars to analyze its usefulness in accelerating the diffusion process of new innovations (Jain, Mahajan, & Muller, 1995; Lehmann & Esteban-Bravo, 2006) and in reconstructing goodwill toward mature products (Heiman, McWilliams, Shen, & Zilberman, 2001a).

Demonstrations are the equivalent of sampling in durable products. Similar to the idea in sample size design of showing enough but not too much, in demonstrations, the consumer is allowed to test a regular product under some constraints that limit her ability to

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2 D'Souza Sean. Why Demonstration Compels Customers To Buy, available at http://www.psychotactics.com/artdemonstration.html

3 http://www.youtube.com/watch?v=d5gHBihOsCs.

4 http://www.youtube.com/watch?v=rnA91nr1s6A.

extract the entire benefit during the demonstration activity. In software products, demonstrations constrain either functionality or duration (Cheng & Liu, 2008), while in cars, the limitations are on duration or mileage. Unlike frequently purchased products, for which the first trial may build an information barrier (Villas-Boas, 2004), in durable products, the frequent changes in technologies and the long turnaround times between purchases are not likely to lead to one-shot efforts at product introduction.

The importance of demonstrations increases with the newness of the innovation (Heiman & Zilberman, 2009) and with competition (Hahn, 2005), which is in turn intensified by globalization. Globalization may increase product supply and intensify competition, which may decrease price margins. Further, the variety of new and unfamiliar brands, as well as components produced overseas, increase consumer uncertainty. These factors, in addition to competition over standards, increase the importance of pre-purchase demonstrations. For example, a consumer considering replacing a PC with a Mac who is aware Apple's statements that "almost any device that connects to a computer via USB, audio cable, or Bluetooth will work with a Mac" and that "your Mac can open most files from your PC"[5] cannot ignore the risk of a non-fit.

Demonstrations are useful in addressing uncertainty over ex ante benefits, i.e., uncertainty regarding the benefits of an unknown product. Before experiencing a product, consumers are uncertain of how it will meet their idiosyncratic needs, a situation termed *fit uncertainty* (Heiman, McWilliams, & Zilberman, 2001b).[6] In the case of competition, there is also uncertainty regarding the benefit of products in the consideration set. Quality signals may not efficiently address this uncertainty, leading to an increase in demonstration efforts (e.g., Hahn, 2005).

Because demonstrations incur a cost for both producers and consumers, they are not guaranteed to serve as the preferred non-price competitive tool under all circumstances. In the case of balanced competition, competition increases the quantity of demonstrations when

[5] http://store.apple.com/uk/browse/campaigns/new_to_mac?mco=NzY2ODc3#officemac.

[6] In 2009, GM announced that it was offering 60-day money-back guarantees (MBG) on Buick, Cadillac, Chevrolet or GMC products (Valdes-Dapena, 2009). Similar to demonstrations, MBG is an ex-post marketing tool that addresses ex-ante pre-purchasing risks (Matthews & Persico,2005).This unusual and risky offer of MBGs on cars worth approximately $25000 that will rapidly depreciate after purchase serves mainly as a strong signal of GM management's confidence in its new models; this confidence was confirmed by the results of a "side by side" test drive held by Edmunds.com of a Buick LaCrosse and a Lexus ES350 in which the Buick was found to be superior to the Lexus.

production costs are low production, but may decrease quantity when production costs are high and the demonstration cost is positive (Heiman, 2009).

The aforementioned literature assumes balanced competition that results in industry-homogenized demonstration strategies, i.e., either all demonstrate or all sell without demonstrations. In contrast to the literature, however, business anecdotes indicate that this is not always the case, as there are examples of asymmetric demonstration strategies (e.g., one producer demonstrates while the others forego demonstrations).

For example, in 2003, as part of its effort to halt its decline in market share, GMC introduced the Overnight Test Drive program, which allowed consumers to test-drive GMC models and compare them to rival models. Early figures indicated that the purchase probability rose to 25% after a side-by-side demonstration (White, 2003). In September 2003, GMC reported that more than 350,000 people took vehicles home overnight, resulting in an increase of more than 100,000 sales (Halliday, 2003). While Volkswagen, Ford Motors, and DiemlerChrysler all responded with similar demonstration programs, Toyota, the market challenger that later became the market leader, did not alter its regular demonstration strategies. Honda also did not alter its strategies. In 2007, GMC dealers offered prospective buyers a side-by-side test drive of the Saturn Aura, Honda Accord, and Toyota Camry (Valdes-Dapena, 2007). Toyota and Honda did not retaliate.

In contrast to the wide variations that characterize demonstration programs in the automobile industry, most software packages come with a homogenized, 30-60 day free trial, regardless of the software's novelty or the producer's market share. While the previous literature provides a sound explanation for the homogenized demonstration strategy of the software industry, it fails to provide an adequate explanation for Honda and Toyota's choice not to respond to GM's large-scale demonstration efforts. The literature also cannot explain why the eBook, a new innovation that induces a large fit uncertainty, is not demonstrated by the market leader, Amazon (Kindle), or by the follower, Sony (E-Reader). Such a lack of demonstrations is counterintuitive, as the eBook's MBG is costlier to marketers in cases of high uncertainty (McWilliams & Zilberman, 2009). The homogenized strategy of selling innovations without a demonstration contrasts with the normative recommendation that giving samples (demonstrations) at or before a product's launch accelerates that product's adoption (Lehmann & Esteban-Bravo, 2006).

We intend to contribute to the literature on this under-researched topic by developing a theory of the imbalanced competitive demonstration strategy. The model presented in this paper analyzes the conditions under which the challenger will demonstrate, the conditions under which the leader will retaliate, and, given that demonstrations are indeed offered, the optimal quality of such demonstrations.

The next section presents a summary of relevant literature. Section 3 models consumer choices and demands with and without product demonstration. Sections 4 and 5 model optimal firm behavior. Section 6 presents a summary of business cases and anecdotal evidence. Section 7 concludes the paper.

2. Literature Review

Similar to advertising, demonstration furnishes consumers with information that enables them to differentiate between rival products and form brand preferences, and thus decreases the elasticity of demand (for example see Dorfman & Steiner, 1954; Grossman & Shapiro, 1984; Sethuraman & Tellis, 2002). Unlike advertising, demonstrations provide first-hand experience that has a greater effect on beliefs more than advertising or word-of-mouth communication (Urban, Hauser, & Roberts, 1990).

Previous literature on demonstrations pertained mostly to the automobile industry, assuming either a monopolistic seller (Roberts & Urban, 1988; Urban et al. 1990; Heiman & Muller 1996) or duopolistic competition where the choice is whether to sell with demonstrations (Hahn, 2005; Heiman, 2009). With the exception of Heiman and Muller, (1996), the subject of demonstration intensity in the automobile industry has not been addressed in the academic literature. The lack of attention the issue of intensity, particularly the effect of competition on intensity, is surprising, given the attention this subject receives in the popular media. The popular media is generally in agreement that the duration of an average demonstration is much shorter than it should be (Kamm, 2005). The subject of optimal demonstration design has received considerable attention in the literature on the software industry (Cakanyildirim & Dalgic, 2002; Cheng & Tang, 2006; Faugère & Tayi, 2007; Cheng & Liu, 2008). However, the literature on software free trials either considers a monopolistic seller or does not address competition's effects on demonstration strategies.

The issues of the frequency and intensity of demonstrations recall the common managerial problem of whether to provide frequent or deep discounts (e.g., Ofir & Winer 2002). However, while a policy of either frequent or deep discounts serves as a signal to price level (e.g., Heil, Day & Reibstien, 2004), this study relates to demonstration's differentiating role, rather than to its informative (signaling) role.

While competition among producers has been shown to increase the quantity of demonstrations when production costs are low and suppress this quantity at high production cost (Heiman, 2009), competition at the dealer level is frequently blamed for decreased demonstration quality (Deneckere, Marvel, & Peck 1996, 1997). Previous economic literature has studied the effects of channel coordination and price competition between dealers on the suboptimal quality of services, which includes, among other variables, "quality demonstration" services (e.g., Telser, 1960; Klein & Murphy 1997). However, this literature did not analyze the effect of competition at the manufacturer level on demonstration decisions, nor did it analyze the effect of competition between producers on demonstration intensity or quantity. It also has not explored the effects of competition on dichotomous demonstration choices (Hahn, 2005; Heiman, 2009).

This paper analyzes the effects of competition on demonstration strategies. Specifically, we study under what conditions competition either enhances or suppresses demonstration efforts in terms of intensity (duration) and frequency (how much).

3. Model Formulation

We consider a durable experience good (Nelson, 1974) sold in a market of *N* potential buyers clustered into three segments and two producers.[7] The assumption of duopolistic competition has been previously used by Dixit (1979), Grossman and Shapiro (1984), Moorthy (1988), Eaton and Grossman (1986), and Klemperer (1987).[8] This assumption is in agreement with empirical findings that suggest that the size of a choice set in the automobile market is between 2 and 3.1 (Horizon, 2004; Lambert-Pandraud, Laurent, & Lapersonne, 2005).

Modeling consumer demand under the assumption of two or three segments and two levels of benefit — high when the product fits and low otherwise — is a common practice (e.g., Gerstner & Holthausen, 1986; Gerstner, Hess, & Holthausen, 1994; Gerstner & Hess, 1995; Venkatesh & Kamakura, 2003; Villas-Boas, 2004, 2006; Ajay & Mengze, 2009). This approach has been advocated by Dixit (1990). We follow this body of literature and assume that Product (1) is designed to meet the needs of Segment (1), and Product (2) is designed to meet the needs of Segment (2). Consumers from Segment (3) do not have a product designed to meet their needs and will experience a low benefit from both products.[9] Prior to experiencing a product, consumers know the distribution of tastes and the average probabilities of fit, but are not informed about their own probability of fit, i.e., their affiliation

[7] We generalize our findings by demonstrating that our results hold for the case of two competitors and two segments. The results are presented in Appendix E.

[8] Some aspects of oligopolistic competition can be modeled in a duopoly using Hoteling's (1929) circle model of differentiated products, which is built on the assumption that a producer relates only to its two closest competitors (e.g., Salop, 1979,Chapter 7; Tirole, 1987).

[9]Our assumption of n producers and n + 1 segments is necessary to guarantee that consumers cannot obtain perfect information on fit after their first experience even if the duration of the demonstration is very long. We prove that our results hold for n =2 producers and two segments.

with a certain segment. The realized benefit of a random consumer who belongs to Segment i and purchases product j is denoted by V^k, where $V^k = \begin{cases} V^H & if\ i = j \\ V^L & if\ i \neq j \end{cases}$[10].

While we assume that all sources of information other than direct experience (e.g., word of mouth, advertising, brand strength) build awareness, form expectations, and may reduce some pre-purchase uncertainty (Roselius, 1971; Derbaix, 1983), such information is not effective in addressing idiosyncratic fit uncertainty (Heiman et al. 2001B). Repeat purchases of frequently purchased products and minimal changes over time from successful brands and models reduce uncertainty, decreasing the need to experience products. Our model pertains to the case of a new technology or a major change in design, where previous experience does not resolve much uncertainty. Therefore, before experiencing a product, buyers are uncertain about the benefits it will yield. Without demonstrations, experience can only be gained by purchasing a product. Consumers choose the product that maximizes their perceived expected utility and yields positive net benefit.

When demonstrations are offered, consumers first decide on their demonstration strategy and make their purchasing decision after gaining experience via demonstrations. Because information acquisition is costly, consumers may chose to adopt a sequential search strategy, i.e., to test one product if the value of the demonstration's information is positive, and then to test the second alternative only if the expected added benefit from a second search is higher than the cost of testing the second product (similar to Roberts & Lattin, 1991 and Villas-Boas, 2004, 2006). Experiencing one product and discovering non-fit does not reveal the benefit of the rival product, so consumers need to experience both products to more gain information on the latter. Because demonstrations do not provide perfect information, consumers may test the two products and still remain uncertain. While idiosyncratic benefits may be realized after a demonstration or purchase, price(s) are assumed known prior to search (this is known as the ex ante pricing game - see Gale 1988).

Consumers are assumed to be risk neutral and to be informed about the probabilities of fit (fit between product and segment). Consumers do not need perfect information; the only requirement is that the perceived ranking of risk accurately represents the marketplace.[11] Let

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[10] The case of $V_1^H \neq V_2^H$ and $V_1^L \neq V_2^L$ yields similar results that can be obtained upon request.

[11] Suppose that consumers' perceptions are wrong. The producer whose probability of fit is underestimated has an incentive to demonstrate, while its rival, whose probability of fit is overestimated, may lose from offering a demonstration. Similar to advertising, the asymmetric demonstration strategy serves as a signal of quality. Consumers are therefore likely to correct their ranking of probabilities of fit.

α_1 and α_2 denote the probabilities of fit for products (1) and (2), respectively. Consumers perceptions of α_1 and α_2 are based on strength of brand, advertisement, price (Milgrom, & Roberts, 1986), the interaction between price and advertisement (Fluet & Garella, 2001), and market share associated with brand strength (Smith & Park, 1992).

In this paper, we refer to the case of unbalanced competition. The case of balanced competition refers to identical probability of fit, equality in production technology, and ex ante undifferentiated products, resulting in zero profits (Tiroll, 1997; Hahn, 2005). Zero profits and ex post differentiated products call for the adoption of demonstration strategies that are used to relieve competitive pressures. The alternative case, that of two unbalanced competitors, is much more intriguing because the stronger brand has the option not to demonstrate.

Demonstrations are costly to the seller. Therefore, sellers may decide to constrain demonstration quality and quantity. The alternative of selling without a demonstration is unattractive because pre-purchase fit uncertainty increases the likelihood of engaging in price wars (Heil & Helsen, 2001).[12] In the software industry, demonstration intensity is controlled either by limiting duration or by restricting the software's functionality (Cheng & Liu, 2008). In the auto industry, intensity is a function of the duration of the demonstration (Heiman & Muller, 1996). This paper will use the duration of the demonstration as a proxy for quality. Let $G(t)$ denote the probability that a potential consumer will realize the exact benefit of the product after a demonstration (whether the product provides V^H or V^L). A consumer remains uncertain of her benefit with a probability of $1-G(t)$. The cost of providing a demonstration is a function of t, specifically $D(t)$.

We begin our study by exploring consumer demand for demonstrations and the subsequent purchase decisions. Section 5 formulates producers' choice rules around selling the product with or without a demonstration. The decision to demonstrate determines the supply of demonstrations. We continue by analyzing decision rules governing demonstration intensity.

4. Consumers' search strategies

As shown later in this paper, the price with demonstrations is higher than the expected benefit without demonstrations (see Appendix D for proof). This excludes the

[12] In the case of imbalanced competition, the less known/weaker producer needs to reduce its price, thereby engaging the stronger firm in a price war. In the case of balanced competition, a price war will end up in zero profits.

alternative of buying without demonstrations. Consumers begin by experiencing the product with the highest expected benefit. Consumer perceptions about probability of fit do not need to be accurate and the only demand is that they represent the actual ranking (order) of various brands' expected benefits (see footnote 10). We assume that while prices are known prior to the search, duration is known only after negotiating with a salesperson, and therefore does not play a role in the demonstration choice. Suppose that $\alpha_1 > \alpha_2$ causing consumers to perceive that the expected benefit of Product (1) without demonstration is greater than that of Product (2). Let P_1^D, P_2^D denote the price with demonstration of Products (1) and (2), respectively. Let S denote the consumer's search cost (the cost of attending a demonstration), which is assumed to be constant. This assumption is consistent with the work of Heiman (2009), who showed that consumers' search cost has only a marginal effect on demonstration choices through in-depth interviews. In those interviews, sales mangers pointed out that consumers will terminate their search before the allocated duration only of they discover that the product does not fit their needs. Because sellers design their optimal duration based on the average time required to learn the product, a product that is returned early from a demonstration cannot be reassigned to another customer. Therefore, both the likelihood of purchase and producers' demonstration costs are not affected by an early termination. Let t_1 be the duration (intensity) of the demonstration of Product (1) and let t_2 denote the duration of the demonstration of product (2). After trying the first product, a consumers will discover with probability $G(t_1)$ that the product provides either V^H or V^L. Thus, after experiencing a product, there is a probability of $1-G(t_1)$ that a consumer may not realize her\his benefit from that product.

After the first demonstration, a consumer may realize V^H with probability $G(t_1)\alpha_1$, or V^L with probability of $G(t_1)(1-\alpha_1)$. If V^H is experienced, the search is terminated and the consumer purchases Product (1). A consumer who realizes V^L with probability $G(t_1)(1-\alpha_1)$ may consider continuing to a second demonstration, terminating her search and purchasing Product (2), or terminating her search and buying nothing. Buying Product (2) without first experiencing it is made possible because the first demonstration revealed to the consumer that s/he does not belong to Segment (1), lowering his/her uncertainty. A consumer who did not realize his/her true type with probability $1-G(t_1)$ may either continue on to test Product (2) or exit the market.

The value of the first demonstration is equal to the expected added benefit of a product that fits minus the search cost (see Appendix B for mathematical detailing) is given by:

$$G(t_1)\alpha_1(V^H - P_1^D) - S \tag{1}$$

The finding that the expected benefit without the demonstration must be negative sets the lower bound of the price. Combining the lower bound with the upper bound derived from Equation (1) yields the pricing rule for the price of the first product with the demonstration, i.e.,

$$V^H - \frac{S}{G(t_1)\alpha_1} \geq P_1^D > \alpha_1 V^H + (1-\alpha_1)V^L \tag{2}$$

The value of the second demonstration depends on the assumptions regarding consumer rationality and the pricing schema of the second producer. Some scholars have assumed that consumers decide on demonstrations sequentially, and when consumers consider a second demonstration, they regard the cost of the first as a sunk cost (Hauser & Wernerfelt, 1990; Roberts & Latin, 1991). Alternatively, consumers may be forward-looking and take into account the likelihood of finding no fit at the first demonstration. They would then incorporate the cost-benefit of a second demonstration when deciding on the first demonstration. We solve for both modes of search and show that the value of the demonstration is higher when consumers are forward-looking (see Appendix B for details). As a result, Product (1)'s price is higher when consumers are forward-looking.

The first demonstration reveals with probability $G(t_1)$ to $(1-\alpha_1)$ that consumers do not belong to the first segment, thereby reducing their uncertainty regarding Product (2) to a level that may be sufficient to guarantee the purchase of Product (2) without the demonstration, i.e.,

$$\frac{\alpha_2}{1-\alpha_1}(V^H - P_2^D) + \frac{\alpha_3}{1-\alpha_1}(V^L - P_2^D) > 0 \tag{3}$$

Consumers who realize that Product (1) is not a fit and consumers who did not reveal their type will continue on to test-drive the second product if:

$$V^H - \frac{S}{G(t_2)\alpha_2} \geq P_2^D \tag{4}$$

5. Producers' profit maximization

5.1. Selling without demonstrations

In the case of imbalanced competition, selling without demonstrations results in two possible outcomes: One, that only the strongest competitor (the one that produces products with a higher probability of fit) survives; or two, the stronger producer equalizes its expected benefit to that of Product (2), earning above-normal profits, while Producer (2)'s price is equal to the marginal cost of production. In the second case, consumers randomly select a product, resulting in identical market shares (see Appendix A for details).

An equilibrium with equal expected benefits and asymmetric profits (positive, zero) exists only if it is more profitable for the stronger producer to have larger margins and smaller volume (half of the market) compared with smaller margins and larger volume (entire market) In both scenarios, when Producer (1) does not demonstrate, Producer (2) can improve its profits only by adopting a demonstration strategy. Thus, we begin by analyzing Producer (2)'s choice given Producer (1)'s strategy set, and continue with Producer (1)'s choice.

5.2 Producers' choices of demonstration strategies

Recalling that without demonstrations, Producer (2)'s profit is zero, positive profits with demonstrations are sufficient to the choice to sell with demonstrations. If Producer (1) demonstrates, then Producer (2)'s profit without demonstrations may be positive. In this case, Producer (2) compares profits with and without demonstrations. If the former is higher, demonstrations are offered. Using the same methodology, we find the conditions that will result in the stronger producer's choice to demonstrate and analyze the sensitivity of the result to the rival's changes in demonstration strategy. Proposition (1) summarizes the effect of competition on the quantity of demonstrations and the stability of the equilibrium.

5.2.1 Producer (2)'s choice of demonstration strategy

Producer (2) optimizes profits considering Producer (1)'s set of demonstration strategies: demonstrate, or sell without demonstration. If Producer (1) demonstrates, then Producer's (2) demonstration cost is lower, but the alternative of selling without demonstrations becomes feasible. Because all consumers begin their search by test-driving Product (1), and $G\left(t_1\right)\alpha_1 N$ of them will end up buying Product (1), the target market for Product (2) is all the consumers who did not reveal fit, i.e., $\left(1-G\left(t_1\right)\alpha_1\right)N$. Alternatively, Producer (2) could target only the segment who revealed that Product (1) does not fit their needs, i.e., $G\left(t_1\right)\left(1-\alpha_1\right)N$. Demonstration must be used to target the larger segment of all consumers who did not reveal fit with Product (1). However, it is possible to target the smaller segment of consumers who found that Product (1) did not fit their needs without demonstrations because the information obtained from the first demonstration sufficiently reduces uncertainty. If Producer (1) does not demonstrate, then Producer (2) has the choice either to demonstrate to the entire market or to exit the market. We begin by analyzing Producer (2)'s choice given that Producer (1) demonstrates and then continue with the choice given that Producer (1) does not demonstrate.

Profit without demonstrations when targeting only the segment that experienced Product (1) and discovered it was not a fit

Selling without demonstrations is possible only to consumers who reveal that Product (1) does not fit their needs with a probability of $G(t_1)(1-\alpha_1)$. Product (2)'s price without demonstrations is equal to the consumer's expected benefit without a second demonstration, i.e., $P_2^N|_{D_1=1} = \dfrac{\alpha_2 V^H + \alpha_3 V^L}{1-\alpha_1}$. The demand for Product (2) is given by $q_2^N = G(t_1)(1-\alpha_1)$, and profit without demonstrations is given by:

$$\pi_2^N|_{D_1=1} = N\left(\frac{\alpha_2 V^H + \alpha_3 V^L}{1-\alpha_1} - C\right)G(t_1)(1-\alpha_1) \quad (5)$$ [13]

Profit without demonstrations increases with the quality of the demonstrations provided by Producer (1) and with the probability of non-fit with Product (1).

Demand and profit with demonstration

After the first demonstration, all consumers who did not reveal that Product (1) fits their type will test the second product if the latter's information value is non-negative. The size of the potential target market for a second demonstration is given by $N\left(1-G(t_1)\alpha_1\right)$. Of this proportion, $G(t_2)\alpha_2$ will reveal that Product (2) fits with their type and purchase it. The quantity sold by Producer (2) is therefore given by $q_2^D|_{D_1=1} = N\left(1-G(t_1)\alpha_1\right)G(t_2)\alpha_2$. Given that Producer (1) demonstrates, Producer (2)'s profit with demonstration is represented by

$$\pi_2^D|_{D_1=1} = N\left(\left(V^H - \frac{S}{G(t_2)\alpha_2} - C\right)G(t_2)\alpha_2 - D\right)\left(1-G(t_1)\alpha_1\right). \quad (6)$$

Producer (2) will demonstrate if $\pi_2^D|_{D_1=1} > \pi_2^N|_{D_1=1}$. A comparison of Equations (5) and (6) indicates that the likelihood of Producer (2)'s offering a second demonstration decreases with the value in the case of no fit, as well as V^L, production cost, demonstration cost, and search cost. The likelihood that Producer (2) will join Producer (1) and offer demonstrations decreases with the quality of Producer (1)'s demonstrations, $G(t_1)$.

[13] selling without demonstrations is possible only if $\begin{cases} V^L \geq C & \forall \alpha_2, \alpha_3 \mid \alpha_1 + \alpha_2 + \alpha_3 = 1 \\ V^L < C & \dfrac{\alpha_2}{\alpha_3} > \dfrac{C - V^L}{V^H - C} \end{cases}$

Producer (2)'s choice given that Producer (1) does not demonstrate

Producer (2)'s profit without demonstrations is zero. Therefore, selling with demonstrations is a crucial condition of its survival. Producer (2)'s profit when Producer (1) sells without demonstrations is given by:

$$\pi_2^D |_{D_1=0} = \left(V^H - \frac{S}{G(t_2)\alpha_2} - C \right) NG(t_2)\alpha_2 - ND \tag{7}$$

Producer (2)'s profits with demonstrations, given that Producer (1) sells without demonstrations, is positive if $V^H > C + \frac{D+S}{G(t_2)\alpha_2}$ (8)

In other words, the likelihood of demonstration increases when the product yields a high value, and demonstration and search costs are low. The lower the probability of fit (the smaller the served market), the higher the adjusted demonstration and search costs, which in turn reduce the likelihood of demonstrations. Comparing Equations (6) and (7) indicates that if Producer (2) chooses to demonstrate given that Producer (1) is demonstrating, then Producer (2) will stick with its demonstration strategy even when Producer (1) stops its demonstration efforts. However, the reverse holds only for large profit margins with demonstrations and low demonstration costs (particularly a cost of zero). To summarize the foregoing, Producer (2) must demonstrate if Producer (1) does not demonstrate or when the marginal production cost is higher than the excepted benefit given that Producer (1) demonstrates. If Producer (1) demonstrates, the likelihood that Producer (2) will also demonstrate decreases with the cost of demonstration and increases the more balanced the two competitors are.

5.2.2 Producer (1)'s choice of demonstration strategy

Producer (1)'s profits without demonstration are a function of Producer (2)'s demonstration strategies and the timing of demonstration offers. If both producers offer demonstrations simultaneously, consumers start by experiencing Product (1), and only if they do not find that Product (1) fits then they may consider experiencing product (2). Producer (1)'s profit with demonstration given that both competitors operate their demonstration programs simultaneously is given by:

$$\pi_1^D |_{D_2=1,0} = \left(\left(V^H - \frac{S}{G(t_1)\alpha_1} - C \right) G(t_1)\alpha_1 - D \right) N \tag{9}$$

Producer (1) will demonstrate, given that Producer (2) demonstrates if its profit with demonstrations (Equation 9) are larger than its profit without demonstrations, $N\left(\alpha_1 V^H + (1-\alpha_1)V^L - C\right)$, i.e.,

$$C \geq \frac{D+S}{1-G(t_1)\alpha_1} + \frac{\alpha_1 V^H\left(1-G(t_1)\right)+(1-\alpha_1)V^L}{1-G(t_1)\alpha_1} \tag{10}$$

Inequality (10) suggests that the stronger Producer (1), and the weaker Producer (2), the slimmer the probability that the strong brand will follow the other. The higher the production cost and the lower the demonstration cost (particularly when the cost is zero), the higher the probability that the leader will offer demonstrations. The likelihood of demonstration decreases when the expected benefit without it is high, i.e., a small difference between value with and without fit and high probability of fit.

Competition increases the quantity of demonstrations if the leader's profit without demonstration is greater than that with demonstration when the follower had not demonstrated, while leader's profit with demonstration becomes relatively more profitable when the follows sells with demonstrations. Formally, competition in demonstrations increases the quantity of demonstrations if

$$G(t_2)\alpha_2 > \alpha_1 V^H\left(1-G(t_1)\right)+(1-\alpha_1)V^L - C\left(1-G(t_1)\alpha_1\right)+D+S \tag{11}$$

Inequality (11) suggests that the stronger Producer (1), and the weaker Producer (2), the slimmer the probability that the stronger will follow the weaker competitor. The more balanced the two competitors and the lower the demonstration costs, in particular zero, the higher the probability of the leader’s following the other. The likelihood of demonstration If demonstrations are offered sequentially, i.e., consumers first experience Product (2) and only then Producer (1) launches its demonstration program, the producer compares its profit with demonstration to that without demonstration given that its rival has already demonstrated. It is easy to show that Condition (10) holds also for sequential demonstration decision.

Our analysis indicates that if Producer (1) chooses to demonstrate, it will not reverse its choice if Producer (2) changes its policy in any direction. The opposite does not hold, i.e., if Producer (1) chooses not to demonstrate given that Producer (2) does not demonstrate, Producer (1) might reverse its decision after Producer (2) alters its demonstration policy and offers demonstration. Proposition (1) summarizes the above discussion.

Proposition (1): The effect of competition on demonstration strategies[14]

A. Highly imbalanced competition either increases or does not affect demonstration quantity. Formally, if $\frac{\alpha_2}{\alpha_1}$ is high and D and S, α_1 and V^L are low are low, competition does not affect demonstration quantity. If $\frac{\alpha_2}{\alpha_1}$ is low and D is high, competition may increase demonstration quantity.

B. The pattern of demonstration wars may be unstable, i.e., producers may change their strategies from demonstration to no demonstration.

C. If consumers are forward-looking, then the likelihood that the leader will provide demonstrations is higher. Therefore, the number of demonstrations increases with competition.

Part A of Proposition (1) pertains to the effect of competition on demonstration quantity. This assertion stems of this finding stems from the balance of power and the cost of demonstrations. In a highly imbalanced market, if the market leader finds that it is more profitable to demonstrate, then the quantity of demonstrations equals the size of the target market. There are two possible outcomes in terms of demonstrations: Producer (1)'s demonstration resolves enough uncertainty to allow Producer (2) to benefit therefrom without the need to invest in demonstrations; or Producer (1)'s demonstrating does not resolve enough uncertainty. If enough uncertainty is resolved (α_2 is large and α_3 is small), then Producer (1) will demonstrate to the entire market, and Producer (2), who had demonstrated to the entire market, will no longer demonstrate. Similarly, if Producer (1) found that it is more profitable not to demonstrate then Producer (2)'s demonstration may reduce the profit without demonstration forcing the leader to demonstrate. Quantity of demonstrations is thus not affected by competition, but rather by the demonstrator's identity. On the other hand, if α_2 is small and α_3 is large, there is still enough uncertainty to justify Producer (2) demonstrating. In this case, both producers demonstrate and the total quantity of demonstrations increases.

5.3 Producers' choices of demonstration quality[15]

Proposition (1) indicates that demonstration costs decline when the rival demonstrates and with the quality of its demonstrations. The higher the quality of the rivals'

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[14] Detailed proof is available from the authors.
[15] Detailed equations on the economics of the producers' profit maximization is presented in Appendix C.

demonstrations, the more uncertainty is resolved, and the lower the quantity of consumers who attend a second demonstration. Suppose Producer (2) must demonstrate. Recall that Producer (1)'s profit with demonstrations given that Producer (2) demonstrates is given by:

$$\pi_1^D |_{D_2=1} = \left(\left(V^H - \frac{S}{G(t_1)\alpha_1} - C \right) G(t_1)\alpha_1 - D \right) N \tag{12}$$

The first-order condition of Equation (12) with respect to the quality of each demonstration is given by:

$$N\left(\left(V^H - C\right)G'(t_1)\alpha_1 - D'\right) = 0\ ^{16} \tag{13}$$

Algebraic manipulation of Equation (13) indicates that the optimal quality of a demonstration is set by equating the inverse value of marginal learning (discovery) to the profit margins adjusted by the perceived probability of fit, i.e., $\left(V^H - C\right)\alpha_1 = \frac{D'}{G'(t_1)}$ (14)

Equation (14) suggests that the optimal demonstration quality is affected by neither the quantity nor the quality of Producer (2)'s demonstrations. The quality of the market leader's demonstrations increases with that producer's strength (market share) and gross profit, and decreases with the marginal cost of demonstrations. Producer (2)'s optimal demonstration quality, regardless of Producer (1)'s demonstration strategy, is set by the same decision role, i.e., $\left(V^H - C\right)\alpha_2 = \frac{D'}{G'(t_2)}$. The relative quality of Producer (2)'s demonstrations depends on the functional forms of D and G. Specifically, if D(t) is linear, i.e., $D(t) = Dt$, then $G'(t_2)$ must be less than $G'(t_1)$, and thus $t_2 > t_1$. If D is convex and G is concave, then demonstration quality depends on the specific functional forms of cost of demonstrations and the learning fostered by those demonstrations. While search cost does not affect the choice of demonstration strategy, it does affect the quantity of demonstrations because it affects the price of the product. Proposition (2) summarizes the discussion above.

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[16] The first-order condition of the profit function for the case of sequential demonstration decision $\left(\left(V^H - \frac{S}{G(t_1)\alpha_1} - C \right) G(t_1)\alpha_1 - D \right) N\left(1 - G(t_2)\alpha_2\right)$ is identical to Equation (13).

Proposition 2:

A. Optimal demonstration quality is affected by neither the quantity nor the quality of the rival's demonstrations.

B. Demonstration quality increases with gross profit, and decreases with marginal cost.

C. The follower will provide higher quality demonstrations if marginal learning is diminishing with demonstration's intensity.

If $G'(t) > 0 \quad G''(t) < 0 \;\; D'(t) > 0 \quad D''(t) = 0$, then $G(t_2) > G(t_1)$, i.e., if consumers learn a lot about the product during the first stages of demonstration and the rate of change in learning diminishes over time (concave learning function), and if the marginal cost of demonstration is constant, then the quality of the follower's demonstration will be higher than that of the leader.

Demonstration quality determines the likelihood that a potential consumer will attend a demonstration. Therefore, if a producer wishes to terminate its demonstration program, it only needs to reduce its demonstration quality.

6. Empirical evidence

Our theoretical results indicate that:

A. If consumers learn a lot about the product during the first stages of demonstration, and the rate of change in learning over time is diminishing (concave learning function), and the marginal cost of demonstration is constant, then the quality of the follower's demonstrations will be higher than that of the leader's.

B. Demonstration quality is not affected by that of the rival.

C. The likelihood that a leader will offer demonstrations increases with competition, while a follower's strategy is not likely to be affected.

D. Competition will not affect demonstration intensity if demonstration costs are zero.

We collected data that allows us to test Hypothesis C. The remaining hypotheses remain to be tested in future studies. Our initial evidence in examining the relationship between competition and demonstration is taken from the industrial 3D software market. The international market for this software is divided between five competitors. We collected data from Graphitech, a leading industrial 3D software manufacturer that caters to metal producers using computerized equipment to manufacture precise metal systems for jewelry, auto parts, and other uses. Graphitech's software allows customers to scan the selected design, make the desired changes, and automatically program the manufacturing machines, all in 3D technology. Graphitech's International Operations Division provided the data to examine the effects of competition on demonstrations in 18 countries over four years. This data enables the examination of various markets with different competitive scenarios and Graphitech competitive positions.

Demonstrations are critical in this market; in fact, the product must be demonstrated before the buyer considers it a relevant option. The demonstration process involves a demonstration of the software's capabilities by either a salesperson or a system engineer, who then leaves the software with the customer for a trial period of 3-6 weeks.

The data on the number of demonstrations in each market (i.e., country) over four years was recorded by Graphitech's information system. We also interviewed the CEO as well as the Marketing, R&D, Production, and Sales managers. Using semi-structured interviews, we collected information on the number of Graphitech's competitors and its relative competitive strength in each country, i.e., whether Graphitech was a market leader or follower. We regressed "demonstrations" (the number of demonstrations in each country in each time period) against "competition" (the number of competitors in each country in each time period), Graphitech executives' "competitive self-position" (self-evaluation as a market leader or follower), and the interaction of these variables. The regression model allowed for arbitrary serial correlations within each country over time, but not between countries. The independent effect of competition on demonstration was negative, though not significantly different from zero ($B = -1.33$, $p > 0.1$). The interaction, however, was statistically significant ($B = 9.18$, $p < 0.01$), suggesting that the effect of competition on demonstration is moderated by self-assessment of competitive market position. Follow-up tests indicate that this effect was positive and significant in markets where Graphitech was a leader ($B = 7.85$, $p < 0.03$), while the same effect was not significantly different from zero where Graphitech was a follower. These results support our theoretical conclusion that the likelihood of a leader offering demonstrations increases with competition, while a follower's demonstration strategy is not likely to be affected.

7. Discussion and Summary

This paper analyzes the effect of competition on demonstration strategies in a market of ex-post differentiated products where each producer targets a distinct segment. Because consumers do not know which product will yield the highest benefit, they need to test all alternatives to resolve uncertainty. However, because demonstrations are costly, there is a need to limit the number of alternatives. Consumers include products in their test choice set based on their expectations, which may in turn be based on prior experience with the brand, advertising, or word of mouth. Our model begins from that point, assuming that producers know consumers' choice sets and can predict their market shares before and after demonstrations. After constructing the choice set, consumers rank the alternatives and test first the products that yield the highest expected benefits. The successive choices are similar to the case of duopolistic competition.

7.1 Review of findings and future research directions

In the case of imbalanced competition, the smaller competitor may need to demonstrate to survive because consumers' default option is to purchase from the larger (stronger) producer. Demonstrations by one producer decreases the rival(s)' market share, in turn increasing the latter's likelihood of offering demonstrations. This in turn naturally increases the quantity of demonstrations in the market. However, multiple demonstrations decrease uncertainty, so a provider that previously demonstrated may reverse its demonstration choice. In such a case, competition decreases the quantity of demonstrations.

The likelihood of offering demonstrations increases with the number of competitors that already demonstrate. Increase in the number of firms that offer demonstration ($N > 2$) intensifies competition, and when it reduces sales (market share), it increases the likelihood of competitive reaction (Lefflang & Wittink, 1996), i.e., providing demonstration, this choice is a discrete marketing mix choice (see Kadiyali, Sudhir, & Rao 2001). We also show that the likelihood of a leader offering demonstrations increases with competition, while a follower's strategy is not likely to be affected. Finally, if demonstration costs are zero, such as in the case of digitalized demonstrations, then competition will not affect demonstration intensity.

Our results indicate that the choice of a demonstration's quality level does not depend on the rival's strategy, and thus can be expanded to any number of competitors, and that under specific conditions, the quality of the follower's demonstration will be higher than that of the leader. This result is in the inverse of that of Fok and Franses (2004).

In semi-structured interviews with five top executives (CEOs and sales managers) of national auto import agencies of a country, all stressed the importance of demonstrations in their selling process. The interviewees indicated that, in general, 30-40% of their sales are executed with intensive demonstrations lasting between 20 minutes and two hours, which, according to their knowledge, is the industry standard. In special cases, the seller demonstrated to 60% and even 100% of the market. Overall, they perceive with varying degrees of correlation that as competition increases over time, so do demonstrations. The interviews suggest that consumers are forward-looking and thus demonstrations provided by a rival increase the likelihood of others demonstrating. Another possibility is that demonstration strategy is a variable that consumers take into consideration when they construct their choice set. This is an empirical matter that can be tested in future studies.

We also analyzed data taken from the industrialized software industry, and our results indicate that while market leaders increase their likelihood of providing demonstrations as a response to competition, followers do not change the intensities of their demonstrations. The data we were able to obtain allowed us to support only one of the four hypotheses. Naturally, while this constitutes a limitation, it also suggests a future direction for empirical study. Access to detailed sales data that includes information on the quantity and quality of demonstrations might produce an interesting empirical paper.

We began our paper with empirical evidence showing that comparative TV commercials are widely used in frequently purchased products. Pre-purchase free trials of consumables, in-store demonstrations, and product sampling are common practices in this category. While there is a large body of literature on the relationship between advertising and pre-purchase trial in consumables, there has been no parallel study on tradeoffs between demonstrations and advertising. We believe that this is a promising direction for future research.

7.2 Managerial applications

Finally, from a managerial point of view, we provide a better understanding of the normative choice rules for a firm considering demonstrations in a competitive market. The decision rules for the follower differ, and while it may need to demonstrate to survive, the leader may choose not to do so. If both firms demonstrate, then the quality of the follower's demonstration is higher. If competing brands are balanced, or the differences between the brands are small, then it is possible that we will find evidence that producers discontinue their demonstration efforts (mixed strategy).

The cost of providing demonstrations is a key factor in determining competitive demonstration strategy: If the marginal cost of providing a demonstration is zero, such as in the case of digital demonstration downloads, then all competitors will demonstrate and their choice to do so is not affected by their rivals' choices. In contrast, if the cost of demonstration is high, then it may drive the small competitors out of the market unless they are able to find a way to offer demonstrations only to customers with high likelihoods of buying. The high efficiency of a demonstration in addressing fit uncertainty and thus improving brand differentiation, together with the high cost of providing quality demonstrations, suggest that demonstration should be used only to increase the likelihood of purchase by reducing risk in the right target market; for all other purposes — such as keeping in touch with customers — building and managing brand value via advertising is more cost effective.

Competition between sellers that sell similar models and brands is devastating. In such cases, demonstration does not help differentiation, and due to its high costs, sellers are forced to reduce its quality as a response to competition. However, a lower quality of demonstration lowers probability of purchase, and therefore, from a managerial perspective, the paper suggests that industries should invest in building demonstration technologies that reduce the marginal cost of demonstration or, alternatively, act as a central designer and allocate demonstration resources between sellers. Apple's concept stores are a good example of centralized demonstration efforts.

While the virtual test drives offered by most automakers provide very little information, they should be used to screen out those consumers who do not belong to the target market. Though this naturally saves consumers time and saves retailers resources, it cannot replace the design of optimal demonstration technologies that provide sufficient information at low cost. Offering pre-owned products (cars) for demonstration reduces the cost of each demonstration.

The efficiency of demonstrations increases if the marketer can segment customers and offer the right product to the right segment. While CEOs are already aware of the advantages of offering demonstrations to a small, defined group — e.g., "*It's a very targeted way to get your product in front of the right kind of consumer*" (Schembari, 2007) — they often fall into the trap of offering demonstrations to larger populations, as in the case of GM, which targeted test drives to the 30% of consumers who do not consider buying GM products.

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Appendix A: Equilibrium without demonstration

Suppose that $\alpha_1 > \alpha_2$. The expected benefit of Product (1) is higher than that of Product (2), i.e., $\alpha_1 V^H + (1-\alpha_1)V^L > \alpha_2 V^H + (1-\alpha_2)V^L$, resulting in $P_1 > P_2$. Without demonstrations there are two possible equilibriums. The first is characterized by the following set of prices { $P_1^N = (\alpha_1 - \alpha_2)(V^H - V^L) + C; P_2^N = C$ } and the second is characterized by $P_1^N = (\alpha_1 - \alpha_2)(V^H - V^L) + \gamma C; P_2^N = \infty$ where $\gamma < 1$.

Both producers may start the price adjustment process by equalizing their prices to the expected benefits, i.e., $P_1^N = \alpha_1 V^H + (1-\alpha_1)V^L; P_2^N = \alpha_2 V^H + (1-\alpha_2)V^L$. Both competitors have an incentive to lower the price by ξ and capture the entire market. The price adjustment terminates when $P_2^N = C$. Producer (1) sets its price without demonstrations, equalizing the expected benefit of Product (1) to that of Product (2), i.e.,

$$\alpha_1 V^H + (1-\alpha_1)V^L - \tilde{P}_1^N = \alpha_2 V^H + (1-\alpha_2)V^L - C \tag{A1}$$

Algebraic manipulation of (A1) yields:

$$\tilde{P}_1^N = C + (\alpha_1 - \alpha_2)(V^H - V^L) \tag{A2}$$

Producer (1)'s profit is given by

$$\Pi_1^N = \tfrac{1}{2} N (\alpha_1 - \alpha_2)(V^H - V^L) \tag{A3}$$

The profit of Producer (2) is zero (normal profit). If the leader reduces its by price by γ where γ is sufficiently small, yet big enough to generate price differentiation, it drives out its competitor. In this case its profit is $N\left((\alpha_1 - \alpha_2)(V^H - V^L) - \gamma C\right)$. The leader will reduce the price if

$$N\left((\alpha_1 - \alpha_2)(V^H - V^L) - \gamma C\right) > \tfrac{1}{2} N (\alpha_1 - \alpha_2)(V^H - V^L) \tag{A4}$$

Simplifying (A4) yields the conclusion that the profit in a monopolistic market, given that the price is lowered to drive the competitor out of the market, is larger than that in a duopolistic market

$$\tfrac{1}{2}(\alpha_1 - \alpha_2)(V^H - V^L) > \gamma C.$$

Appendix B: Consumers' choice of demonstration

We proved that if demonstrations are offered, the expected benefit of each of the products is lower than their prices (see Appendix D for details), i.e.,

$$\alpha_1\left(V^H - P_1^D\right) + \left(1-\alpha_1\right)\left(V^L - P_1^D\right) < 0 \tag{B1}$$

and $\alpha_2\left(V^H - P_2^D\right) + \left(1-\alpha_2\right)\left(V^L - P_2^D\right) < 0$ (B2)

The value of the first demonstration is given by:

$$G\left(t_1\right)\left(\alpha_1\left(V^H - P_1^D - S\right) + \left(1-\alpha_1\right)\left(-S\right)\right) + \left(1-G\left(t_1\right)\right)\left(-S\right) \tag{B3}$$

Which is equal to:

$$G\left(t_1\right)\alpha_1\left(V^H - P_1^D\right) - S \tag{B4}$$

The requirement that the value of a first demonstration must be non-negative sets the upper boundary of the price of Product (1) with demonstration, i.e.,

$$V^H - \frac{S}{G\left(t_1\right)\alpha_1} \geq P_1^D \tag{B5}$$

Combining Conditions (B8) and (B5) sets the upper and lower bounds of price with demonstrations:

$$V^H - \frac{S}{G\left(t_1\right)\alpha_1} \geq P_1^D > \alpha_1 V^H + \left(1-\alpha_1\right)V^L \tag{B6}$$

After the first demonstration, a random consumer reveals with probability $\left(1-\alpha_1\right)G\left(t_1\right)$ that s/he does not belong to the first segment, thereby reducing the uncertainty regarding Product (2) to a level that may be sufficient to guarantee purchase without demonstration, i.e.,

$$\frac{\alpha_2}{1-\alpha_1}\left(V^H - P_2^D\right) + \frac{\alpha_3}{1-\alpha_1}\left(V^L - P_2^D\right) > 0 \tag{B7}$$

When $P_2^D > \frac{\alpha_2}{1-\alpha_1}V^H + \frac{\alpha_3}{1-\alpha_1}V^L$, then all consumers who did not reveal Product (1) to be a fit, $N\left(1-G\left(t\right)\alpha_1\right)$, will continue on to test the second product if

$$V^H - \frac{S}{G\left(t_2\right)\alpha_2} \geq P_2^D \tag{B8}$$

If consumers are forward-looking, then the expected cost of a second demonstration is taken into account when the first demonstration is considered. The value of the first demonstration is thus given by:

$$\begin{aligned} &G(t_1)\alpha_1\left(V^H - P_1^D - S\right) + G(t_1)(1-\alpha_1)G(t_2)\frac{\alpha_2}{1-\alpha_1}\left(V^H - P_2^D - 2S\right) \\ &+G(t_1)(1-\alpha_1)G(t_2)\frac{\alpha_3}{1-\alpha_1}(-2S) + G(t_1)(1-\alpha_1)\left(1-G(t_2)\right)(-2S) \\ &+\left(1-G(t_1)\right)G(t_2)\left(\alpha_2\left(V^H - P_2^D - 2S\right) + (1-\alpha_2)(-2S)\right) + \left(1-G(t_1)\right)\left(1-G(t_2)\right)(-2S) \end{aligned} \quad \text{(B9)}$$

Further simplification of equation (B9) yields that the net value of demonstration information when consumers are forward-looking is given by:

$$G(t_1)\alpha_1\left(V^H - P_1^D\right) + G(t_2)\alpha_2\left(V^H - P_2^D\right) - \left(G(t_1)\alpha_1 + 2\left(1-G(t_1)\alpha_1\right)\right)S \quad \text{(B10)}$$

The net value of demonstrations when consumers are forward-looking is larger than the net value of demonstrations when decisions are made sequentially if:

$$G(t_1)\alpha_1\left(V^H - P_1^D\right) + G(t_2)\alpha_2\left(V^H - P_2^D\right) - \left(G(t_1)\alpha_1 - 2\left(1-G(t_1)\alpha_1\right)\right)S > G(t_1)\alpha_1\left(V^H - P_1^D\right) - S$$
(B11)

Algebraic manipulation of (B11) yields:

$$G(t_2)\alpha_2\left(V^H - P_2^D\right) > \left(1 - G(t_1)\alpha_1 S\right) \quad \text{(B12)}$$

Because $S > \left(1 - G(t_1)\alpha_1 S\right)$ and $G(t_2)\alpha_2\left(V^H - P_2^D\right) > S$, then the value with forward-looking is higher than that when search decision is sequential.

Appendix C: Producers' choices

Producer (2)'s choice of demonstration strategy

Profit without demonstrations when targeting the segment of consumers who revealed after the first demonstration that Product (1) does not fit:

The price without demonstrations is set equal to the expected benefit without demonstrations, i.e.,

$$P_2^N\,|_{D_1=1} = \frac{\alpha_2}{1-\alpha_1}V^H + \frac{\alpha_3}{1-\alpha_1}V^L. \quad \text{(C1)}$$

Replacing $1-\alpha_1$ with $\alpha_2 + \alpha_3$ yields:

$$P_2^N\,|_{D_1=1}=\frac{\alpha_2 V^H+\alpha_3 V^L}{\alpha_2+\alpha_3} \tag{C2}$$

The requirement that only consumers who discovered that Product (1) is not a fit purchase Product (2) without demonstration is presented by:

$$\alpha_2\left(V^H-\frac{\alpha_2 V^H+\alpha_3 V^L}{\alpha_2+\alpha_3}\right)+\left(1-\alpha_2\right)\left(V^L-\frac{\alpha_2 V^H+\alpha_3 V^L}{\alpha_2+\alpha_3}\right)<0 \tag{C3}$$

Algebraic manipulation of (C3) yields that inequality (C3) is satisfied when $-\alpha_2\alpha_1\left(V^H-V^L\right)<0$, which always holds.

The demand for Product (2) without demonstrations given that Producer (1) demonstrates is given by:

$$q_2^N\,|_{D_1=1}=G\left(t_1\right)\left(1-\alpha_1\right) \tag{C4}$$

Profit without demonstration is given by:

$$\pi_2^N\,|_{D_1=1}=\left(\frac{\alpha_2 V^H+\alpha_3 V^L}{\alpha_2+\alpha_3}-C\right)NG\left(t_1\right)\left(1-\alpha_1\right) \tag{C5}$$

The strategy of selling without demonstration given that the rival demonstrates is feasible only if $\pi_2^N\,|_{D_1=1}>0$. i.e., $\frac{\alpha_2 V^H+\alpha_3 V^L}{1-\alpha_1}>C$. If (5) does not hold, then the follower will demonstrate as long as profits with demonstrations are non-negative.

Profit with demonstration given that Producer (1) sells with demonstrations:

The target market for a second demonstration is given by $N\left(1-G\left(t_1\right)\alpha_1\right)$. Of this, $G\left(t_2\right)\alpha_2 N$ consumers will reveal that Product (2) is a fit and purchase it. Thus, the quantity sold by Producer (2) is given by $q_2^D\,|_{D_1=1}=N\left(1-G\left(t_1\right)\alpha_1\right)G\left(t_2\right)\alpha_2$.

Given that Producer (1) demonstrates, Producer (2)'s profit with demonstration is represented by $\pi_2^D\,|_{D_1=1}=\left(V^H-\frac{S}{G\left(t_2\right)\alpha_2}-C\right)N\left(1-G\left(t_1\right)\alpha_1\right)G\left(t_2\right)\alpha_2-N\left(1-G\left(t_1\right)\alpha_1\right)D$. (C6)

Producer (2) will demonstrate if $\pi_2^D>\pi_2^N$. Comparing Equations (C6) and (C5) yields that the condition for demonstration is given by:

$$\left(V^H - \frac{S}{G(t_2)\alpha_2} - C\right)\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2 - \left(1 - G(t_1)\alpha_1\right)D$$
$$> \left(\frac{\alpha_2 V^H + \alpha_3 V^L}{\alpha_2 + \alpha_3} - C\right)G(t_1)(1-\alpha_1) \qquad \text{(C7)}$$

Algebraic simplification of (C7) yields that Producer (2) will demonstrate given that Producer (1) demonstrates if:

$$V^H - \frac{G(t_1)\left(\alpha_2 V^H + \alpha_3 V^L\right)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2} > C\left(1 - \frac{G(t_1)(1-\alpha_1)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2}\right) + \frac{S+D}{G(t_2)\alpha_2} \qquad \text{(C8)}$$

Producer (2)'s choice given that Producer (1) does not demonstrate:

Because profit without demonstration is zero, Producer (2) must demonstrate to survive. Therefore, if profit with demonstration is positive, demonstrations will be offered. Producer (2)'s profit given that producer (1) does not demonstrate is given by:

$$\pi_2^D \big|_{D_1=0} = \left(V^H - \frac{S}{G(t_2)\alpha_2} - C\right)NG(t_2)\alpha_2 - ND. \qquad \text{(C9)}$$

Simplifying equation (C9) yields a necessary and sufficient condition for demonstration, given by: $V^H > C + \frac{D+S}{G(t_2)\alpha_2}$ (C10)

Comparing (C7) to (C10) indicates that if Producer (2) demonstrates, given that Producer (1) sells with demonstrations, then Producer (2) will not reverse its choice if Producer (1) changes its policy, i.e., terminate its demonstrations program.

If (C7) requires that $V^H > \frac{D+S}{G(t_2)\alpha_2} + C + \left(\frac{\alpha_2 V^H + \alpha_3 V^L}{\alpha_2 + \alpha_3} - C\right)\frac{G(t_1)(1-\alpha_1)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2}$

while (C10) requires that $V^H > C + \frac{D+S}{G(t_2)\alpha_2}$. If

$\frac{D+S}{G(t_2)\alpha_2} + C + \left(\frac{\alpha_2 V^H + \alpha_3 V^L}{\alpha_2 + \alpha_3} - C\right)\frac{G(t_1)(1-\alpha_1)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2} > C + \frac{D+S}{G(t_2)\alpha_2}$ then

inequality (C7) is more binding. The reverse requires that (C8) holds, i.e.,

$$V^H - \left(\alpha_2 V^H + \alpha_3 V^L\right)\frac{G(t_1)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2} > C\left(1 - \frac{G(t_1)(1-\alpha_1)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2}\right) + \frac{S+D}{G(t_2)\alpha_2}$$

$$V^H - C > \frac{G(t_1)(1-\alpha_1)}{\left(1 - G(t_1)\alpha_1\right)G(t_2)\alpha_2}\left(\frac{\alpha_2 V^H + \alpha_3 V^L}{1-\alpha_1} - C\right) + \frac{S+D}{G(t_2)\alpha_2}$$

Replacing $\frac{\alpha_2 V^H + \alpha_3 V^L}{1-\alpha_1}$ with P_1^N and assigning $V^H - \frac{S}{G(t_2)\alpha_2} = P_2^D$ yields that if

$$\left(P_2^D - C\right)\left(\frac{\left(1-G(t_1)\alpha_1\right)G(t_2)\alpha_2 - G(t_1)(1-\alpha_1)}{1-G(t_1)\alpha_1}\right) > D \qquad \text{(C10)}$$

Because $G(t_2)\alpha_2 - \left(G(t_2)\alpha_1\alpha_2 - (1-\alpha_1)\right)G(t_1) > 0$, then (C10) is likely to hold when the margins with demonstrations are high and the demonstration costs are low. For zero demonstration costs, (C10) always holds.

Producer (1)'s choice of demonstration strategy

Producer (1)'s profits without demonstration are a function of Producer (2)'s demonstration strategies. There are 2x2 possible combinations, and their corresponding profits are given by:

$$\pi_1^D |_{D_2=0} = \left(V^H - \frac{S}{G(t_1)\alpha_1} - C\right) NG(t_1)\alpha_1 - ND \qquad \text{(C11)}$$

$$\pi_1^N |_{D_2=1} = \begin{cases} \left(\frac{\alpha_1 V^H + \alpha_3 V^L}{1-\alpha_2} - C\right) NG(t_2)(1-\alpha_2) & \frac{\alpha_2\gamma C - \left(\alpha_1 V^H - C\right)(1-\gamma)}{\alpha_2 + \alpha_2(1-\gamma)} \geq V^L \\ \left(\alpha_1 V^H + (1-\alpha_1)V^L - C\right) N\left(1-G(t_2)\alpha_2\right) & otherwise \end{cases}$$

where $\gamma = \frac{G(t_2)}{1-G(t_2)\alpha_2}$ (C12)

$$\pi_1^N |_{D_2=0} = \left(\alpha_1 V^H + (1-\alpha_1)V^L - C\right) N \qquad \text{(C13)}$$

Producer (1) will demonstrate, given that Producer (2) does not demonstrate, if:

$$\left(V^H - \frac{S}{G(t_1)\alpha_1} - C\right) G(t_1)\alpha_1 - D > \left(\alpha_1 V^H + (1-\alpha_1)V^L - C\right)\left(1-G(t_2)\alpha_2\right) \qquad \text{(C14)}$$

Algebraic manipulation of (C14) yields that the leader will demonstrate regardless of competition if:

$$C > \frac{D+S}{1-G(t_1)\alpha_1} + \frac{\alpha_1 V^H \left(1-G(t_1)\right) + (1-\alpha_1)V^L}{1-G(t_1)\alpha_1} \qquad \text{(C15)}$$

Equation (C15) suggests the likelihood that the leader will demonstrate even when Producer (2) does not demonstrate, is increasing both for high production cost and low demonstration cost. The likelihood of demonstration decreases when the expected benefit without it is high, i.e., a small difference between value with and without fit and high probability of fit.

Competition increases the quantity of demonstrations if the leader's profit without demonstration is greater than that with demonstration when the follower had not demonstrated, while leader's profit with demonstration becomes relatively more profitable when the follows sells with demonstrations. Formally, competition increases the quantity of demonstrations if:

$$C > \frac{D+S}{1-G(t_1)\alpha_1} + \frac{\alpha_1 V^H \left(1-G(t_1)\right) + (1-\alpha_1)V^L}{1-G(t_1)\alpha_1}$$

and

$$\left(V^H - \frac{S}{G(t_1)\alpha_1} - C\right) G(t_1)\alpha_1 - D > \left(\alpha_1 V^H + (1-\alpha_1)V^L - C\right)\left(1-G(t_2)\alpha_2\right) \quad \text{(C16)}$$

Algebraic manipulation of Inequality (C16) indicates that Producer (1) will demonstrate given that Producer (2) demonstrates, if:

$$C > \frac{D+S+\left(\alpha_1 V^H + (1-\alpha_1)V^L\right)\left(1-G(t_2)\alpha_2\right) - \alpha_1 G(t_1)V^H}{1-G(t_1)\alpha_1 - G(t_2)\alpha_2} \quad \text{(C17)}$$

Simultaneous Inequalities (C15) and (C17) indicates that competition increases the quantity of demonstrations if [17] V^L is very low, the probabilities of fit are low, demonstration and search costs are low while production costs are medium. (C17) suggests that the stronger Producer (1), and the smaller Producer (2), the slimmer the probability that the stronger will follow the follower. The more balanced the two competitors and the lower the demonstration costs, in particular zero, the higher the probability of the leader's following the follower.

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[17] $G(t_2)\alpha_2 > \alpha_1 V^H \left(1-G(t_1)\right) + (1-\alpha_1)V^L - C\left(1-G(t_1)\alpha_1\right) + D + S$

If Producer (1) responds to its rival's (Producer 2's) demonstration program by operating a similar demonstration, yet only after all consumers have experienced Product (2), then Producer (1) will also demonstrate when Producer (2) sells without demonstrations. Proof:

When $\frac{C\left(1-\gamma\left(1-\alpha_2\right)\right)-\left(1-\gamma\right)\alpha_1 V^H}{\alpha_2+\alpha_3\left(1-\gamma\right)} \leq V^L$, the profit without demonstration is given by $\left(\alpha_1 V^H+\left(1-\alpha_1\right)V^L-C\right)N\left(1-G\left(t_2\right)\alpha_2\right)$. Producer (1) will demonstrate if:

$$\left(V^H-\frac{S}{G\left(t_1\right)\alpha_1}-C\right)G\left(t_1\right)\alpha_1-D>\left(\alpha_1 V^H+\left(1-\alpha_1\right)V^L-C\right) \qquad \text{(C18)}$$

Producer (1) will demonstrate if:

$$C>\frac{D+S}{\left(1-G\left(t_1\right)\alpha_1\right)}+\frac{\alpha_1 V^H\left(1-G\left(t_1\right)\right)+\left(1-\alpha_1\right)V^L}{\left(1-G\left(t_1\right)\alpha_1\right)} \qquad \text{(C19)}$$

Producer (1) will demonstrate given that Producer 2 does not demonstrate if condition (C15), $C>\frac{S+D}{\left(1-G\left(t_1\right)\alpha_1\right)}+\frac{\alpha_1 V^H\left(1-G\left(t_1\right)\right)+\left(1-\alpha_1\right)V^L}{\left(1-G\left(t_1\right)\alpha_1\right)}$ is satisfied.

Note that Conditions (C18) and (C15) are identical.

The opposite does not always hold, i.e., if Producer (1) chooses to demonstrate given that Producer (2) does not demonstrate, Producer (1) might reverse its decision after Producer (2) alters its demonstration policy.

Appendix D

Suppose that the price is lower than the expected benefit without demonstration. Under this pricing schema, if demonstrations are offered and the expected value of a demonstration to the consumer, which equals the expected loss if non-fit is realized, is higher than consumer search costs, all consumers will take the demonstration offer. Because the net demand (demand after demonstration) is lower, producer revenue declines. Because the producer does not raise its price, the lower demand and the additional cost of demonstration decrease profits. Therefore, if demonstrations are offered, the price must equal the reservation price of consumers who discovered a fit minus their adjusted search cost. Formally, suppose that consumers would have purchased the leading product without demonstration. i.e., $\alpha_1\left(V^H-P_1^D\right)+\left(1-\alpha_1\right)\left(V^L-P_1^D\right)>0$. A consumer will test Product (1) if :

$$G(t_1)\left(\alpha_1\left(V^H - P_1^D - S\right) + (1-\alpha_1)(-S)\right) + \left(1-G(t_1)\right)\left(\alpha_1\left(V^H - P_1^D - S\right) + (1-\alpha_1)\left(V^L - P_1^D - S\right)\right)$$
$$> \alpha_1\left(V^H - P_1^D\right) + (1-\alpha_1)\left(V^L - P_1^D\right) > 0$$

(D1)

(D1) is further simplified, yielding:

$$G(t_1)(1-\alpha_1)\left(P_1^D - V^L\right) > S \qquad \text{(D2)}$$

Thus, Product (1) would be experienced only if the expected gain from discovering non-fit is larger than the cost of search.

We prove formally the case in which Producer (2) demonstrates. The formal proof is similar to the case where Producer (2) does not demonstrate. The profit of Producer (1) when the price equals the reservation price of a consumer who found a fit is given by

$$\Pi_1^D \mid \left\{P = P^H\right\} = N(1-\alpha_2)\tilde{\alpha}_1 G(t_1)\left(V^H - \frac{S}{\tilde{\alpha}_1 G(t_1)} - C\right) - N(1-\alpha_2)D(t_1) \quad \text{(D3)}$$

where $\tilde{\alpha}_1 = \dfrac{\alpha_1}{1-\alpha_2}$. The profit of Producer (1) when the price equals the expected benefit without demonstration, yet demonstrations are still offered, is given by:

$$\begin{aligned}&\Pi_1^D \mid \left\{P_1^D = \tilde{\alpha}_1 V^H + (1-\tilde{\alpha}_1)V^L\right\} = \\ &N(1-\alpha_2)\tilde{\alpha}_1 G(t_1)\left(P_1^D - C\right) + \left(1-G(t_1)\right)N(1-\alpha_2)\left(P_1^D - C\right) - N(1-\alpha_2)D(t_1)\end{aligned} \quad \text{(D4)}$$

$P_1^D = \tilde{\alpha}_1 V^H + (1-\tilde{\alpha}_1)V^L$ is optimal if the left element of equation (D4) is larger than the left element of equation (D3), i.e.,

$$\begin{aligned}&N(1-\alpha_2)\left(\tilde{\alpha}_1 G(t_1) + \left(1-G(t_1)\right)\right)\left(P_1^D - C\right) - N(1-\alpha_2)D(t_1) > \\ &N(1-\alpha_2)\tilde{\alpha}_1 G(t_1)\left(V^H - \frac{S}{\tilde{\alpha}_1 G(t_1)} - C\right) - N(1-\alpha_2)D(t_1)\end{aligned} \quad \text{(D5)}$$

Simplifying (D5) yields :

$$V^L + \frac{S}{G(t_1)(1-\tilde{\alpha}_1)} - G(t_1)(1-\tilde{\alpha}_1)V^L - \tilde{\alpha}_1 G(t_1)V^H - \left(1-G(t_1)\right)C > 0 \qquad \text{(D6)}$$

Replacing $V^L + \dfrac{S}{G(t_1)(1-\tilde{\alpha}_1)}$ with P_1^D and $-G(t_1)(1-\tilde{\alpha}_1)V^L - \tilde{\alpha}_1 G(t_1)V^H$ with $-P_1^D$ indicates that (D6) holds for $-\left(1-G(t_1)\right)C > 0$, which is impossible.

QED.

Appendix E: Consumers' choice of demonstration N = 2

We proved that if demonstrations are offered, the expected benefit of each of the products is lower than their respective prices (see Appendix D for details), i.e.,

$$\alpha_1\left(V^H - P_1^D\right) + \left(1-\alpha_1\right)\left(V^L - P_1^D\right) < 0 \tag{E1}$$

and

$$\alpha_2\left(V^H - P_2^D\right) + \left(1-\alpha_2\right)\left(V^L - P_2^D\right) < 0 \tag{E2}$$

The value of the first demonstration is given by:

$$G\left(t_1\right)\left(\alpha_1\left(V^H - P_1^D - S\right) + \left(1-\alpha_1\right)\left(-S\right)\right) + \left(1-G\left(t_1\right)\right)\left(-S\right) \tag{E3}$$

Which is equal to:

$$G\left(t_1\right)\alpha_1\left(V^H - P_1^D\right) - S \tag{E4}$$

The requirement that the value of a first demonstration must be non-negative sets the upper boundary of Product (1)'s price with demonstration, i.e.,

$$V^H - \frac{S}{G\left(t_1\right)\alpha_1} \geq P_1^D \tag{E5}$$

Combining Conditions (E4) and (E5) sets the upper and lower bounds of price with demonstrations:

$$V^H - \frac{S}{G\left(t_1\right)\alpha_1} \geq P_1^D > \alpha_1 V^H + \left(1-\alpha_1\right)V^L \geq P_1^N \tag{E6}$$

After the first demonstration, a random consumer reveals with probability $\left(1-\alpha_1\right)G\left(t_1\right)$ that s/he does not belong to the first segment, thereby resolving the uncertainty regarding Product (2). Consumers who discover that Product (1) does not fit their need will purchase Product (2) without demonstration if $V^H \geq P_2^D$.

All consumers who do not reveal Product (1) to be a fit or non-fit, i.e., $N\left(1-G\left(t\right)\right)$, will continue on to test-drive the second product if:

$$V^H - \frac{S}{G(t_2)\alpha_2} \geq P_2^D$$ [18] (E7)

Producer (2)'s choice of demonstration strategy

The profit of Producer (2) given that Producer (1) does not demonstrate is given by:

$$\pi_2^D|_{D_1=0} = \left(V^H - \frac{S}{G(t_2)\alpha_2} - C\right) NG(t_2)\alpha_2 - ND \quad \text{(E8)}$$

Simplifying Equation (C9) yields that a necessary and sufficient condition for demonstration is given by: $V^H > C + \dfrac{D+S}{G(t_2)\alpha_2}$ (E9)

Profit with demonstration given that Producer (1) sells with demonstrations:

After the first demonstration, consumers who reveal that Product (1) fits their needs will purchase it. Consumers who reveal that Product (1) is not a fit will purchase Product (2), and thus the target market for a second demonstration is all consumers who remain uncertain about fit after their first demonstration, i.e., $N(1-G(t_1))$. Of them, $G(t_2)\alpha_2$ consumers will reveal that Product (2) is a fit and purchase it. Thus the quantity sold by Producer (2) is given by: $q_2^D|_{D_1=1} = N\left(G(t_1)(1-\alpha_1) + (1-G(t_1))G(t_2)\alpha_2\right)$. (E10)

Given that Producer (1) demonstrates, Producer (2)'s profit with demonstration is represented by:

$$\pi_2^D|_{D_1=1} = \left(V^H - \frac{S}{G(t_2)\alpha_2} - C\right) N\left(G(t_1)(1-\alpha_1) + (1-G(t_1))G(t_2)\alpha_2\right) - N(1-G(t_1))D$$

(E11)

Producer (2) will demonstrate if $\pi_2^D > 0$.

$$\pi_2^D|_{D_1=0} = \left(V^H - \frac{S}{G(t_2)\alpha_2} - C\right) NG(t_2)\alpha_2 - ND > 0 \text{ if } V^H > C + \frac{D+S}{G(t_2)\alpha_2} \quad \text{(E12)}$$

$\pi_2^D|_{D_1=1} > 0$ if:

---

[18] The value of the second demonstration is given by:

$$G(t_2)\left(\alpha_2\left(V^H - P_2^D - S\right) + (1-\alpha_2)(-S)\right) + (1-G(t_2))(-S)$$

$$V^H > C + \frac{\left(1-G\left(t_1\right)\right)D}{\left(G\left(t_1\right)\left(1-\alpha_1\right)+\left(1-G\left(t_1\right)\right)G\left(t_2\right)\alpha_2\right)} + \frac{S}{G\left(t_2\right)\alpha_2} \quad \text{(E13)}$$

The left-hand side of Inequality (E13) is larger than that of Inequality (E12), and thus if Producer (2) decides to demonstrate given that Producer (1) demonstrates, Producer (2) will certainly demonstrate when Producer (1) does not demonstrate.

Given that Producer (1) demonstrates, Producer (2) has the option to sell without demonstration to the segment that revealed that Product (1) is not a fit, i.e., $NG\left(t_1\right)\left(1-\alpha_1\right)$.

The profit under this strategy is given by: $N\left(V^H - C\right)G\left(t_1\right)\left(1-\alpha_1\right)$

Producer (2) will choose not to demonstrate if:

$$\left(V^H - C\right)G\left(t_1\right)\left(1-\alpha_1\right) > \left(V^H - \frac{S}{G\left(t_2\right)\alpha_2} - C\right)\left(G\left(t_1\right)\left(1-\alpha_1\right)+\left(1-G\left(t_1\right)\right)G\left(t_2\right)\alpha_2\right) - \left(1-G\left(t_1\right)\right)D$$

(E14)

$$C + \frac{DG\left(t_1\right)\left(1-\alpha_1\right)}{\left(1-G\left(t_1\right)\right)G\left(t_2\right)\alpha_2} + \frac{S}{G\left(t_2\right)\alpha_2}\left(\frac{G\left(t_1\right)\left(1-\alpha_1\right)}{\left(1-G\left(t_1\right)\right)G\left(t_2\right)\alpha_2}+1\right) > V^H \quad \text{(E15)}$$

However, if $C > V^H$, the market does not exist, and thus Producer (2) must demonstrate.

Producer (1)'s choice of demonstration strategy

Since Producer (2) must demonstrate while Producer (1)'s profit without demonstration is positive, Producer (1) needs to compare its profit with demonstration to that without demonstrations.

$$\pi_1^D \mid_{D_2=1} = \left(V^H - \frac{S}{G\left(t_1\right)\alpha_1} - C\right)NG\left(t_1\right)\alpha_1 - ND \quad \text{(E16)}$$

The profit without demonstration given that Producer (2) demonstrates is

$\pi_1^N \mid_{D_2=1} = \left(\alpha_1 V^H + \left(1-\alpha_1\right)V^L - C\right)N\left(G\left(t_2\right)\left(1-\alpha_2\right)+1-G\left(t_2\right)\right)$, which is equal to

$$\pi_1^N \mid_{D_2=1} = N\left(\alpha_1 V^H + \left(1-\alpha_1\right)V^L - C\right)\left(1-G\left(t_2\right)\alpha_2\right) \quad \text{(E17)}$$

Equations (E16) and (E18) are identical to the case with three segments. While Inequality (E15) differs from the condition of demonstration by the follower, it is very similar thereto, and Condition (E12) is identical to Equation (8).

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