NET Institute*

www.NETinst.org

Strategic Product Pre-announcements in Markets with Network Effects

Jay Pil Choi
Michigan State University

Eirik Gaard Kristiansen
Michigan State University

Jae Nahm
HKUST, Hong Kong

Strategic Product Pre-announcements in Markets with Network Effects

by

Jay Pil Choi*, Eirik Gaard Kristiansen**, and Jae Nahm***

September 2005

Abstract

It is a widely adopted practice for firms to announce new products well in advance of actual market availability. The incentives for pre-announcements are stronger in markets with network effects because they can be used to induce the delay of consumers' purchases and forestall the build-up of rival products' installed bases. However, such announcements often are not fulfilled, raising antitrust concerns. We analyze the effects of product pre-announcements in the presence of network effects when firms are allowed to strategically make false announcements. We also discuss their implications for consumer welfare and anti-trust policy.

*   Department of Economics, Michigan State University, 101 Marshall Hall, East Lansing, Michigan 48824-1038, Tel: 517-353-7281, E-mail: choijay@msu.edu (Corresponding Author)

**   Norwegian School of Economics and Business Administration Hellev. 30, 5045 Bergen, Norway, Tel: 44 55959278, E-mail: eirik.kristiansen@nhh.no

***   Department of Economics, HKUST, Clearwater Bay, Kowloon Hong Kong, Tel: 852-2358-7626, E-mail: jnahm@ust.hk

I. Introduction

We analyze the effects of strategic product pre-announcements in markets with network effects. It is a widely adopted practice for firms to announce new products well in advance of actual market availability. The incentives for pre-announcements to delay the purchase decision of consumers are stronger in markets with network effects because they can be used to induce the delay of consumers' purchases and forestall the build-up of rival products' installed bases. However, such announcements often are not fulfilled. Consequently, the practice of pre-announcement has been derisively referred to as "vaporware" since many of the products either never reach the market or are significantly delayed.[1] As such, the practice has been subject to scrutiny by policymakers for its potential predatory and anti-competitive implications. One prominent example in antitrust is the IBM case in the 1960s in which IBM announced the development of its System/360 line of computers and related peripherals far in advance of their availability. The Department of Justice subsequently accused IBM of making premature and predatory product announcements regarding the product line.[2]

In relation to the landmark antitrust case of U.S. vs. IBM, Fisher, et al. (1983) provide an early discussion of information transmission, product pre-announcement, and reputation. In defense of such a practice, Fisher, et al. argue:

> In general, there is no reason to inhibit the time when a firm announces or brings products to the marketplace. Customers will be the final arbiters of the product's quality and the firm's reputation. Broken promises and unattractive products can be expected to lead quickly to a loss of credibility and sales. . . . Advance announcement of truthful information about products cannot be anticompetitive. Indeed, such announcement is procompetitive; competition thrives when information is good. . . . If those announcements of its belief were made in good faith, then it was imparting information to consumers and competitors as to what it expected to do. Even if it was later unable to do those things, the imparting of such information can only aid competition. Only deliberate falsehood could

---

[1] See Bayus et al. (2001) for an entertaining discussion on the origin of the term "vaporware."
[2] For a detailed discussion of the IBM case, see Fisher et al. (1983). See also Levy (1997) for antitrust implications of vaporware.

possibly be anticompetitive here, and that is highly improbable since a firm that practiced such tactics would acquire a tarnished reputation that would ill-serve it in the future (pp. 289-290).

We provide a simple model of product pre-announcements in markets with network effects and discuss its implications for social welfare and anti-trust policy. In particular, we develop a reputation model of vaporware in which firms can make product pre-announcements. More specifically, we consider a situation where a firm develops a new product while a competitive product already exists. Consumers need to decide whether to purchase the currently available product or to wait until the advent of the new product. For this decision to be relevant, we assume that, due to switching costs, consumers cannot purchase the existing product and later make another purchase when the new product is available (see Klemperer (1995)). However, consumers do not have perfect information about the quality/availability of the new product, which is the firm's private information. We ask whether or not consumers can rely on firm-provided information concerning the quality/availability of the new product. Since the firm always prefers to have the consumers wait for its product, the firm's pre-announcement cannot have any informational content if the game is played only once. Thus, we consider a pre-announcement game played twice to investigate under what circumstances the firm can convey the information in a credible way.

In our approach, different types of firms with different R&D capabilities have different chances of introducing a high-quality product in the second product cycle. We derive the value of being honest *endogenously* and show that the value of being honest increases in the chance of introducing a high-quality product in the second product cycle. That is, firms with higher R&D capabilities care more about their reputation. We find that there can be an informative equilibrium where the product pre-announcement can convey information about the product's quality. The equilibrium is characterized by a cut-off point where semi-separation of types takes place; only types higher than the cut-off point have the incentive to tell the truth when product quality is low. Thus, in equilibrium we can observe various outcomes—both lying and telling the truth—depending on the firm's type.

This paper builds on our previous work. In Choi, Kristiansen, and Nahm (2004, 2005), we analyze the welfare effects of product pre-announcement and discuss its anti-trust implications. We model explicitly the formation of reputation in a repeated product pre-announcement game and characterize the equilibrium in which private information held by the firm is partially revealed. Our analysis shows that in the model *without* network effects, product pre-announcements always benefit consumers. Even if the firm might make misleading claims about its product quality, consumers can rationally discount the firm's claims, and the firm's announcement can be at least partially revealing, which helps consumers make a better decision. In this paper, we extend the analysis to markets with network effects to check the robustness of the previous analysis. Formal economic analysis of product pre-announcements that explicitly accounts for network effects and the possibility of false announcements is scarce. The current paper intends to fill this gap in the literature.

Our paper relates two strands of the literature, one on technology adoption with network effects and the other on reputation. Farrell and Saloner (1986) provide an early analysis of how product pre-announcements affect consumers' technology adoption decisions. In response to the argument made above by Fisher, et al. (1983), they point out the possibility of anti-competitive product pre-announcements in the presence of *network effects*. In particular, they construct a dynamic model of technology adoption in which the timing of the announcement of a new *incompatible* product can critically determine whether the new product succeeds in replacing the existing technology. Due to the presence of network effects, even if the potential users who decide to wait are indeed well-informed and their welfare is increased as a result of product pre-announcement, their adoption of the new technology may adversely affect both the users in the installed base and later adopters who might have preferred the old technology to the new one. Their paper, however, considers only truthful pre-announcements. The possibility of false announcements and consumers' potentially incorrect inference about the informational content of announcements is not analyzed.

Several papers also analyze how product pre-announcements can be used as a strategic tool. For instance, Bayus, et al. (2001) present a model in which product pre-announcement is used as a strategic signal for rival firms. In the paper, intentional

vaporware is used as a way to dissuade competitors from developing their own competing products. Our proposal, in contrast, intends to analyze a communication channel between the firm and consumers. Thus, the purpose of product pre-announcement in Bayus, et al. (2001) is entry deterrence, whereas the purpose of our model is to persuade consumers to wait until the arrival of its new product.[3] Also, Bayus, et al. adopt an *ad hoc* assumption that making a false announcement is costly, without any micro-foundation for penalty costs associated with false announcements. In contrast, we develop a model of vaporware in which the reputation cost is *endogenously* derived. Gerlach (2004) is another paper that examines an entrant's incentives to pre-announce new products when such pre-announcements may induce the incumbent to cut prices and preempt the market. He shows that the possibility of a preemptive move by the incumbent may prevent the entrant from making announcements. In contrast to our proposal, he focuses primarily on verifiable announcements.[4] We show how reputational concerns may prevent firms from making false announcements.

Levy (1997) explores anti-trust implications of vaporware. As in our model, he considers a situation in which consumers do not know the veracity of the firm's announcement when it is made. However, he does not explicitly model reputation. Dranove and Gandal (2003) provide an empirical analysis of pre-announcement effects in the DVD market. In the standard war between the DVD and DIVX formats, they show that the pre-announcement of DIVX slowed down the adoption of DVD technology, which is consistent with our theory.

Our research proposal is also related to the theoretical literature on strategic information transmission, which examines how an uninformed party elicits information from an informed party when these two sides can engage in 'cheap talk.' (See Crawford and Sobel (1982) and Sobel (1985), for example.) Sobel (1985) analyzes how reputation is formed in a cheap talk under the assumption that an 'honest' type always tells the truth. One important paper that is closely related to ours is Morris (2001). As in Sobel (1985) and our approach, Morris (2001) analyzes reputational concerns that arise endogenously

---

[3] Haan (2003) is another paper that develops a model of vaporware as a means of entry deterrence. In his model, however, separating equilibria do not exist and all firms claim that they have innovation. As a result, pre-announcement has no informational content. In contrast, in our paper, only a subset of firms lie, and, as a result, the pre-announcement is partially informative.

[4] If false announcements were allowed, all firms would lie in equilibrium.

when a static cheap-talk game is repeated. He considers an advice game in which an informed advisor wishes to convey a valuable piece of information to an uninformed policymaker with *identical* preferences. In a twice-repeated cheap-talk game, Morris analyzes how reputation concerns affect cheap talk between informed and uninformed sides. In particular, he focuses on the possibility that reputational concerns might lead to a situation in which *no* information is conveyed in equilibrium. He calls this "political correctness." [5]   Both our model and Morris' deal with how concerns about future reputation can impact the transmission of information today.   One major difference is that he considers a situation in which the advisor has incentives to tell the truth in a static context, but the advisor's incentives to tell the truth are distorted in a dynamic context. In contrast, we consider a situation in which the informed party always has incentives to lie and no information can be conveyed in a static context. Therefore, we investigate how reputational concerns can mitigate this problem.

The remainder of the paper is organized in the following way. In section II, we set up the basic model of product pre-announcements with network effects. Section III derives conditions for an equilibrium in which more innovative firms have incentives to maintain their reputations and make truthful announcements, while less innovative firms have incentives to make false announcements. Overall, the announcements are partially revealing in equilibrium. In section IV, we analyze welfare implications of product pre-announcements. Section V contains concluding remarks.

II.   The Model

In this section, we construct a simple model of product pre-announcements in the presence of *network effects*. More specifically, we consider a durable goods market in which consumers make a choice concerning the timing of their purchase. [6] The main purpose of pre-announcements in our model is to induce consumers to forego their opportunity to purchase currently available products and wait until the new product is available. When the product choice is largely irreversible, there will be more incentives

---

[5] This paradoxical result takes place when the policymaker thinks that the advisor might be biased in favor of one decision, and the advisor, wanting his/her valuable advice to have an impact on future decisions, does not wish to be thought of as biased.

[6] See Choi (1994) for an analysis of irreversible technology choice with network effects in the *absence* of any product announcements.

for such pre-announcements in the presence of network effects. If the firm succeeds in delaying consumers' purchases, it will not only have a larger consumer base but also face a smaller installed base of old products.

We aim to answer the question of whether pre-announcements of a new product can help consumers make better purchasing decisions even when a firm's announcement is non-binding and non-verifiable. Indeed, if the game is played only once, there would be no room for the product pre-announcements to be informative. However, if there are repeated interactions between the firm and consumers, the firm tries to build its reputation. In Choi et al. (2004), we considered a scenario in which the firm and consumers interact repeatedly and developed a reputation model of vaporware. We derived conditions under which product pre-announcements can be informative and analyze the welfare effect of product pre-announcement. In this paper, we extend the analysis to markets with network effects.

Consider a game that is played by consumers and a firm that develops a *sequence* of new products. For simplicity, we assume that there are two sequential product cycles and that a firm can introduce a new product in each cycle. Let δ denote the time discount factor between the first- and second- product cycles.

In each product cycle, there are two time periods, t=1, 2. There are also two potential consumers, 1 and 2, who arrive sequentially at time t=1 and 2, respectively. We can easily reinterpret each consumer as a group of consumers. As long as they share the same preferences and we make a coordination assumption that they collectively choose the Pareto optimal outcome, the analysis will be the same. Consumers have unit demand for the product in each product cycle. In the first period (t=1), an existing product is competitively supplied. The firm that develops a new product introduces the new product in the second period (t=2). For simplicity, there is no time discount between periods within the same product cycle.[7] In period 1, consumer 1 has two options. She can choose the existing product that is competitively supplied, or she can wait until period 2 when she can make an optimal choice given the quality and price of the new product that will be available by that time. For the first period purchase decision to have dynamic

---

[7] This assumption is made without any loss of generality and discounting within the product cycle can easily be accommodated.

implications, we assume that, once the consumer purchases in the first period, she is locked in and cannot switch to the new product in the second period due to switching costs (see Klemperer, 1995). In addition, I assume that the product in consideration exhibits network effects. The exiting product and the new product are incompatible. I denote by Δ the value each consumer attaches to the network effects conferred when the other consumer buys the same product.

The quality of the new product can be either high (H) or low (L). The *ex ante* probability that the firm can develop a high-quality product is denoted by θ, which can be considered the firm's type. There are two types of the firm, θ_1 and θ_2, $\theta_1 < \theta_2$. The firm knows its own type, but consumers know only the distribution of the firm types. The prior belief that the firm is of type θ_2 is q. The firm's type is assumed to be invariant across product cycles and represents the firm's innovativeness or research capability. The realization of product quality given the firm's type, however, is independent across product cycles. The firm that is in the process of developing a new product knows the quality of the product in the first period of each product cycle. The firm can announce the quality of the product to consumers in period one to persuade consumers to delay their purchase. We assume that product pre-announcements are *cheap talk* and, thus, do not entail any direct costs to make.

For simplicity, we assume that the production costs for both old and new products are zero. Therefore, the existing product is competitively supplied at a price of zero. The stand-alone value of the currently available product in period one is given by w per period. When consumer 1 delays her purchase and waits until period 2, she foregoes the current consumption benefit that can be considered her waiting costs.[8] The new product developed by the firm is superior to the existing product, regardless of its quality realizations. If the quality realization is low, the amount of *additional* stand-alone value the new product provides vis-à-vis the existing product is given by $v_L (> 0)$, that is, its

---

[8] As mentioned earlier, we can easily extend the analysis to a group of consumers in each cohort as long as consumers are homogeneous in their waiting costs (w) and, therefore, make the same decision as to purchase/wait in the first period. In Choi *et al.* (2004), we assume a group of consumers and allow different consumption patterns according to their waiting costs in a model *without* network effects. Analyzing the case of heterogeneous waiting costs with different consumption patterns is much more complex in the presence of network effects since we need to keep track of the number of installed base that affects future competition.

stand-alone value is $w + v_L$. If the quality realization is high, we assume that the amount of *additional* stand-alone value consumers derive from the new product is random and denoted by $\tilde{v}_H$. It can take $\bar{v}_H$ with probability α and $\underline{v}_H$ with probability $(1 - \alpha)$, where $\bar{v}_H > \underline{v}_H$ $(>\Delta)$. The actual value is *private* information revealed to consumers only in the second period and is unknown to them in the first period. This assumption reflects the fact that when new features are promised for new software, it would be difficult to know in advance how much additional value such features would provide.[9] The assumption also implies that the firm sets its price for the new product knowing only the distribution of the values, not the actual value for the consumers. As will be shown shortly, this assumption gives consumers an incentive to wait for the new product by preventing the firm from extracting all consumer surplus.

Suppose that consumer 1 has purchased the existing product in the first period and the quality realization of the new product is low. Then consumer 2 has two options. If he makes the same choice as consumer 1 by purchasing the competitively supplied product, he receives the surplus of $w + \Delta$. In contrast, if he purchases the new product at the price of p, his surplus would be $w + v_L - p$. There are two cases to consider depending on the relative magnitudes of Δ and v_L. If $\Delta > v_L$, the quality increase is not sufficient for the supplier of the new product to overcome the installed-base effect and consumer 2 follows suit and buys the old product. However, if $\Delta < v_L$, the firm can charge $p = v_L - \Delta$ and sell the new product to consumer 2. In such a case, incompatibility will prevail and the network benefit of Δ is lost.

Now let us analyze a subgame in which consumer 1 delayed her purchase, and the quality realization of the new product in the second period is low. In this case, the old and new products compete on a level playing field without any installed base. The new product will be sold to both consumers at the price of $p = v_L$.

To limit the number of cases to consider, let us assume that $\Delta > v_L$.[10] With this assumption, consumer 1's payoff from purchasing the currently available product is given

---

[9] We could also introduce uncertainty in the incremental value when the quality realization is low without affecting the main qualitative results.

[10] The other case can be easily analyzed without affecting the main results.

by $w + (w + \Delta) = 2w + \Delta$ since consumer 2 will also purchase the same product to enjoy network benefits. In contrast, if she waits, she will pay the price of v_L in the second period and gets the payoff of $(w + \Delta)$. The assumption thus implies that consumer 1's optimal choice is to purchase the available product in period 1 if the quality of new product is known to be low for sure. From the perspective of the firm with a low quality product, its profit is zero if consumer 1 purchases the old product whereas its profit becomes $2v_L$ if consumer 1 decides to wait. Thus, the benefit of inducing the first period consumer to wait is given by $2v_L$.

Now consider the case where the firm has a high quality product. Suppose that consumer 1 has already made a purchase in the first period. Once again, consumer 2 has two options. If he purchases the competitively supplied product like consumer 1, he has surplus of $w + \Delta$ as before. In contrast, if he purchases the new product at the price of p, his surplus would be $w + \tilde{v}_H - p$. The firm has two candidates for the optimal price, $(\bar{v}_H - \Delta)$ or $(\underline{v}_H - \Delta)$. If the firm charges $(\bar{v}_H - \Delta)$, consumers will buy the product only with probability α. Thus, the expected payoff is given by $\alpha\,(\bar{v}_H - \Delta)$. In contrast, if the firm charges $(\underline{v}_H - \Delta)$, consumers buy the product for sure with a profit of $(\underline{v}_H - \Delta)$. To limit the number of cases to consider, we make the following assumption, which implies that the optimal price for the firm is $(\underline{v}_H - \Delta)$:

$$\alpha < \frac{\underline{v}_H - \Delta}{\bar{v}_H - \Delta} \tag{1}$$

The assumption also implies that when consumer 1 makes her purchase in the first period, if the new product is of high quality, she will be stranded by consumer 2 who will choose to purchase it. Thus, her payoff is given by $2w$ if she makes a purchase in the first period.

Now let us analyze a subgame in which consumer 1 delayed her purchase, and the quality realization of the new product in the second period is high. The optimal price for the firm is either $\bar{v}_H$ or $\underline{v}_H$. If the firm charges $\bar{v}_H$, consumers will buy the product only with probability α. Thus, the expected payoff is given by $\alpha\,(2\bar{v}_H)$. In contrast, if the firm charges $\underline{v}_H$, consumers buy the product for sure and obtains a profit of $2\underline{v}_H$.

Inequality (1) above implies that $\alpha < \dfrac{v_H}{\bar{v}_H}$. Thus, the optimal price for the firm is $\underline{v}_H$.

As a result, when consumer 1 decides to wait until period 2, her expected surplus is given by $w + \Delta + \alpha\,(\bar{v}_H - \underline{v}_H)$. Recall that her expected payoff is given by $2w$ if she makes a purchase in the first period. To have a meaningful analysis, we assume that:

$$w < \Delta + \alpha\,(\bar{v}_H - \underline{v}_H) \qquad\qquad (2)$$

The condition above says that consumer 1 will prefer to wait if the firm is known to have a high quality product for sure.

Let μ denote consumers' belief that the firm has a high-quality product. Then, we can define a critical level of belief $\bar{\mu}$ at which consumers are indifferent between purchasing the currently available product in the first period and waiting for the new product until the second period.

$$\bar{\mu}\,(2w) + (1 - \bar{\mu})(2w + \Delta) = \bar{\mu}\,(w + \Delta + \alpha\,(\bar{v}_H - \underline{v}_H)] + (1 - \bar{\mu})(w + \Delta)$$

That is,

$$\bar{\mu} = \frac{w}{\Delta + \alpha(\bar{v}_H - \underline{v}_H)} \qquad\qquad (3)$$

We assume that $\bar{\mu}$ is between θ_1 and θ_2. This implies that if the firm's type is known to be θ_2, the expected quality of the new product is high enough that the consumer in the first period will delay her purchase until the second period. However, if the firm's type is known to be θ_1, she will not wait.

Let π_w^H (π_w^L) denote the profit for the firm that introduces a high-quality product (low-quality product) when consumer 1 waits. In our model, we have $\pi_w^H = 2\underline{v}_H$ and $\pi_w^L = 2v_L$ with $\pi_w^H > \pi_w^L > 0$. The corresponding profits when consumer 1 does not wait are $\pi_{nw}^H = (\underline{v}_H - \Delta)$ and $\pi_{nw}^L = 0$, respectively. If the new product is of high quality, it is mutually beneficial for consumer 1 (see inequality (2)) and the firm ($\pi_w^H > \pi_{nw}^H$) that the consumer wait for the new product. This implies that if announcing a high-quality product induces consumers to wait until period two, the firm with the low-quality product has an incentive to mislead consumers and announce a high-quality product. Therefore,

product pre-announcements cannot impart any information to consumers if the game is played only once.   In the next section, we analyze whether or not we can have an informative equilibrium if the announcement game is played repeatedly.

III. The Existence of an Informative Equilibrium

Now we allow for the possibility that the firm announces in the first period the product quality in each cycle prior to its release in the second period.   We are searching for a Perfect Bayesian equilibrium (PBE) in which all players' strategies are sequentially optimal and consumers' beliefs about the firm's type are derived by Bayes' rule, whenever possible.   We assume that product pre-announcements are 'cheap talk.' As in any model of cheap talk, we have a babbling equilibrium in which the cheap talk has no meaning and is rationally ignored by the receiver.   Instead, we are interested in whether we can have an informative equilibrium in which the firm, by making an announcement, can convey credible information on the quality of its product to consumers.   We analyze how reputations are formed in equilibrium and how concern over reputation affects cheap talk.

Figure 1 describes the timing of the game.   We denote the discount factor between the two product cycles by δ.   We can capture differences in the importance of the two products by the discount factor δ. Even though the two product cycles entail different products, we assume that all parameters are the same across cycles.[11]   We can easily modify the model to allow different parameter values with additional notation.

---

[11] We also maintain the same sequential structure across product cycles in which consumer 1 chooses first in the first period and consumer 2 makes choices in the second period.   However, this assumption is unnatural if we imagine a scenario in which consumers 1 and 2 differ only in terms of arrival time during the first product cycle.   Under such a scenario, it would be natural to assume that they make the decision simultaneously in the second product cycle since both of them are already there.   Allowing simultaneous choice would not change the qualitative results.   Alternatively, we can think of consumers in the second product cycle as different groups but with the knowledge of past history in the market.

Period 1

After observing the quality of the new product, the firm announces its quality.

Consumer 1 chooses to wait or buys the current product, which is competitively supplied.

Period 2

A new product is introduced, and its true quality is revealed. Consumer 2 makes a decision given the choice of consumer 1. If consumer 1 waited, they choose simultaneously.

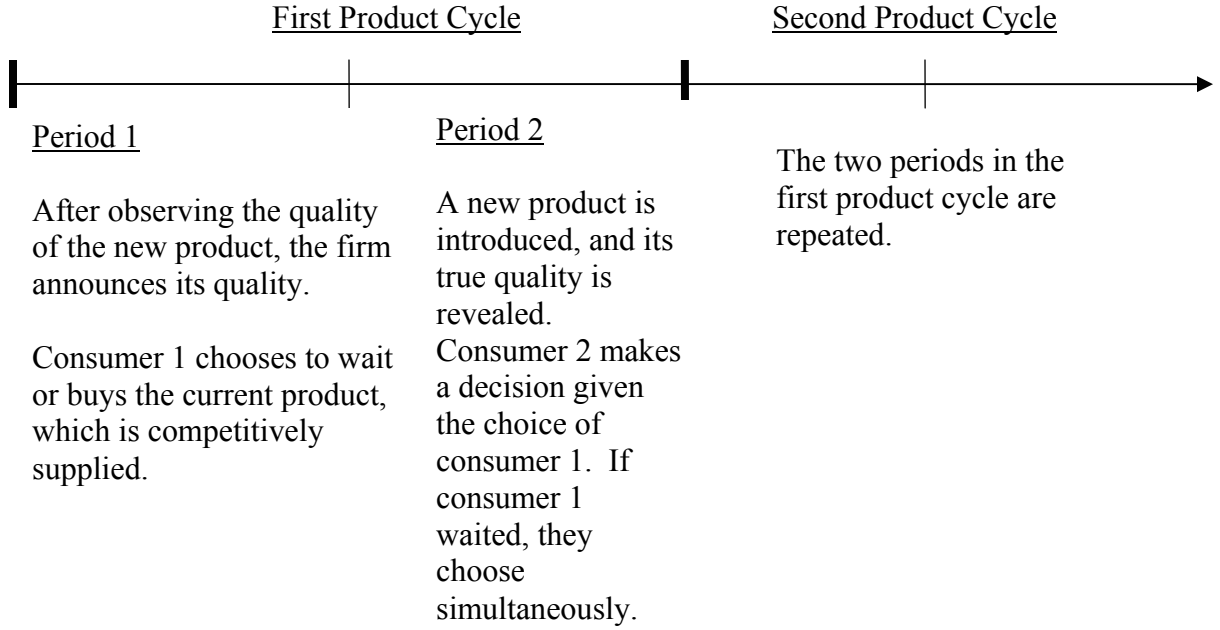The two periods in the first product cycle are repeated.

Figure 1: The Timing of Moves

As usual, we proceed by using backward induction to derive the informative equilibrium. In the second product cycle, the firm's announcement does not convey any credible information since it is the last interaction between the firm and consumers. Thus, consumers make their decision based only on their updated belief about the firm's type derived from the past product cycle. Let μ_2 denote the consumers' updated belief of the firm's probability of delivering a high-quality product in the second product cycle. We interpret μ_2 as the reputation level of the firm. If μ_2 is higher than $\bar{\mu} = \dfrac{w}{\Delta + \alpha(\bar{v}_H - \underline{v}_H)}$, consumers will wait until period two in the second product cycle.

If consumer 1 does not wait until the second product cycle, a firm of type θ's *ex ante* expected profit (i.e., before knowing whether it has a high- or low-quality product), is given by $\pi_{nw}(\theta) = \theta\pi_{nw}^H + (1-\theta)\pi_{nw}^L = \theta(\underline{v}_H - \Delta)$. However, if consumers wait, the firm's *ex ante* expected profit is $\pi_w(\theta) = \theta\pi_w^H + (1-\theta)\pi_w^L = \theta(2\underline{v}_H) + (1-\theta)(2v_L)$. Note that $[\pi_w(\theta) - \pi_{nw}(\theta)] = \theta(\underline{v}_H + \Delta) + (1-\theta)(2v_L)$ is increasing in θ. That is, even though

13

all types benefit from consumers' waiting, type θ_2 has a higher return from waiting than type θ_1. As a result, type θ_2 has more reputation concerns than type θ_1 if a better reputation induces consumers to wait, which implies that the Spence-Mirrles single crossing property holds.[12] Due to the single crossing property, we can obtain a separating equilibrium in which higher types make an honest announcement, while lower types could intentionally make a false announcement. We are interested in conditions under which the firm's reputation concerns lead the firm to make an honest announcement of its product quality in the first product cycle.

In particular, we are looking for an informative equilibrium with the following properties:

(1) If the firm has a high-quality product in the first cycle, both types truthfully announce a high-quality product. Consumer 1 takes the announcements as partially true and waits until the second period in the first product cycle. Since her belief is confirmed, she updates her belief upward and also waits for a new product in the second product cycle.

(2) If the firm has a low-quality product in the first cycle,

(i) the θ_1-type firm makes a false announcement that its product is of high quality, and consumer 1 is misled into waiting for the new product in the first cycle. She will revise her belief downward and does not wait in the second cycle.

(ii) the θ_2-type firm makes a truthful announcement (or does not make an announcement), and consumer 1 does not wait in the first cycle. However, she will revise her belief upward and reward the firm by waiting in the second product cycle.

Knowing that a firm might make an intentional false announcement, consumer 1 updates her belief about the new product's quality based on the firm's announcement strategy. Given the equilibrium strategies of the firm above, if the firm announces a high-quality product in the first cycle, the updated belief that the product is of high quality in the first cycle is given by:

$$\mu_1^H = \frac{q}{q\theta_2 + (1-q)} \theta_2 + \left(\frac{1-q}{q\theta_2 + (1-q)} \right) \theta_1 \qquad (4)$$

---

[12] See Mas-Colell, Whinston, and Green (1995) for more details.

For the product pre-announcements to have impacts on consumer's waiting decision, we assume the following:

$$\mu_1{}^H > \bar{\mu} \tag{5}$$

This assumption implies that when the firm announces a high-quality product, consumer 1 will wait for the new product in the first cycle. If the announcement turns out to be true, then consumer 1 will update her belief about the firm's type according to the Bayes rule. The posterior probability that the firm is a high type can be derived as:

$$\Pr(\theta = \theta_2 | Quality = H)$$

$$= \frac{\Pr(\theta = \theta_2)\Pr(Quality = H \mid \theta = \theta_2)}{\Pr(\theta = \theta_2)\Pr(Quality = H \mid \theta = \theta_2) + \Pr(\theta = \theta_1)\Pr(Quality = H \mid \theta = \theta_2)}$$

$$= \frac{q\theta_2}{q\theta_2 + (1-q)\theta_1}$$

Thus, μ_2 becomes $\frac{q\theta_2}{q\theta_2 + (1-q)\theta_1}\theta_2 + (\frac{(1-q)\theta_1}{q\theta_2+(1-q)\theta_1})\theta_1$. If the announcement turns out to be false, then μ_2 becomes θ_1. Since $\frac{q\theta_2}{q\theta_2+(1-q)\theta_1} > \frac{q\theta_2}{q\theta_2+(1-q)}$, equation (5) implies that $\frac{q\theta_2}{q\theta_2+(1-q)\theta_1}\theta_2 + (\frac{(1-q)\theta_1}{q\theta_2+(1-q)\theta_1})\theta_1 > \bar{\mu}$. In other words, if the firm introduces a high-quality product in the first cycle, consumer 1 will wait in the second cycle as stated in the description of the equilibrium.

Finally, if the firm does not make an announcement in the first cycle, then consumer 1 does not wait in the first cycle, and $\mu_2 = \theta_2$. Since we assume that $\theta_2 > \bar{\mu}$, consumer 1 will wait in the second cycle.

Let us check whether the firm's strategies described above satisfy incentive compatibility constraints in the first product cycle. If the firm has a high-quality product in the first cycle, it is obvious that it is an optimal strategy for the firm to make an honest announcement. Now consider the case in which the firm has a low-quality product in the first cycle. If the firm makes a false announcement, consumers will wait, and the firm's profit in the first product cycle is $\pi_w^L = 2v_L$. However, the firm loses its reputation and consumers will not wait in the second product cycle. As a result, its expected profit in the second product cycle is $\delta \pi_{nw}(\theta) = \delta [\theta \pi_{nw}^H + (1-\theta)\pi_{nw}^L] = \delta\theta(\underline{v}_H - \Delta)$. In contrast, if the firm does not make an announcement, it gets zero profit in the first product cycle, and

its expected profit in the second product cycle is $\delta\pi_w(\theta) = \delta[\theta\pi_w^H + (1-\theta)\pi_w^L] = \delta[\theta(2\underline{v}_H) + (1-\theta)(2v_L)]$. Consumers wait in the second product cycle and the firm's expected profit in such a scenario depends on the ex ante probability that the firm can develop a high quality product (i. e., the firm's type, θ).

The incentive compatibility condition for type θ_2 with a low-quality product to make a true announcement in the first cycle is given by:

$$\pi_{nw}^L + \delta[\theta_2 \pi_w^H + (1-\theta_2)\pi_w^L] \geq \pi_w^L + \delta[\theta_2 \pi_{nw}^H + (1-\theta_2)\pi_{nw}^L] \tag{6}$$

The corresponding condition for type θ_1 with a low-quality product to make a false announcement in the first cycle is given by:

$$\pi_w^L + \delta[\theta_1 \pi_{nw}^H + (1-\theta_1)\pi_{nw}^L] \geq \pi_{nw}^L + \delta[\theta_1 \pi_w^H + (1-\theta_1)\pi_w^L] \tag{7}$$

In our model, the two conditions above can be rewritten as:

$$\theta_1 < \frac{1-\delta}{\delta}\frac{2v_L}{\underline{v}_H + \Delta - 2v_L} < \theta_2 \tag{8}$$

Thus, we can conclude that if conditions (5) and (8) are satisfied, the informative equilibrium described above is possible.[13]

IV. Welfare Analysis

In the previous section, we conducted a positive analysis identifying conditions under which product pre-announcements can convey (partial) information to potential consumers. In this section, we conduct a normative analysis to investigate implications of product pre-announcements for social welfare and antitrust policy. In Choi et al. (2004), we showed that allowing pre-announcements helps consumers make better decisions, and its *ex ante* effect on expected consumer welfare is positive in a set-up without network effects. Here we find that this result is robust to the introduction of network effects.

Proposition 1. Allowing pre-announcement improves expected consumer welfare in the presence of network effects.

---

[13] It can easily be verified that the set of parameters satisfying conditions (5) and (8) is non-empty.

Proof. See the Appendix.

In the Appendix, we prove that consumers taken together are always better off with product pre-announcements, even if the firm is allowed to make misleading claims about its future product. In fact, it turns out that consumer 2's surplus is independent of consumer 1's purchase/delay decision. More specifically, consumer 2's surplus is $(w + \Delta)$ if the product is of low quality whereas it is given by $(w + \alpha (\bar{v}_H - \underline{v}_H) + \Delta)$ if the product is of high quality, regardless of whether consumer 1 waits in the first period or not. Therefore, product pre-announcements have no effects on consumer 2's welfare.

We turn our attention to consumer 1's welfare and argue that consumer 1 is unambiguously better off with product pre-announcements. The intuition for this result is the same as in Choi et al. (2004) who shows a similar result in the absence of network effects. Consumer 1 can rationally discount the firm's claims, and the firm's announcement can be at least partially revealing. Therefore, it can only help consumer 1 make a better decision.

In particular, there are two effects that help consumer 1. In the *first* product cycle, the high-type firm $(\theta = \theta_2)$ reveals its quality truthfully when they have a low-quality product and, thus, enhance their reputation. [14] In contrast, such valuable information will not be available in the absence of product pre-announcements. If the firm announces a high-quality product, consumers will update their beliefs accordingly, taking into account the fact that low-type firms with a low-quality product will lie. As a result, consumer 1, who is assumed to be rational, makes better ex ante decisions with product pre-announcements in an informative equilibrium.

In the *second* product cycle, there is an additional informational benefit from better *sorting*. To be more precise, we can consider three possible histories in the second product cycle. If the firm introduced a high-quality product in the first cycle, the consumer welfare in the second product cycle would be the same across the two regimes since consumers have the same beliefs about the firm in both cases and behave in the same way. However, if the firm introduced a low-quality product in the first cycle, consumers can sort the firm into one of the two types depending on whether or not they

---

[14] Morris (2001) calls this the *discipline effect*.

have lied. As a result, consumer 1 can make better ex ante decisions in the second cycle with product pre-announcements.   With these two informational effects taken together, we can conclude that consumer 1 is better off in our model.

Our welfare result for consumers thus formalizes the argument in Fisher, et al. (1983) and Levy (1997). They reason that "[b]roken promises and unattractive products can be expected to lead quickly to a loss of credibility and sales" (Fisher, et al., 1983). As a result, firms will refrain from making false announcements due to concerns about reputation, and "there is no reason to inhibit the time when a firm announces or brings products to the market place." In a sense, however, our result is stronger than their claim. In our model, deliberate misrepresentations take place in equilibrium due to the existence of different firm types. Nonetheless, we were able to show that consumers are better off with product pre-announcements as long as consumers are aware of such incentives for misrepresentation on the part of the firm.[15]

We can also show that in this simple, twice-repeated cheap-talk game, the firm's *ex ante* profit also increases. A proof is given in the Appendix. Thus, the total surplus (consumer surplus + firm profit) also increases with the possibility of product pre-announcements.

IV.   Concluding Remarks

It is common practice for firms to announce new products well in advance of actual market availability.   This practice, often called "vaporware," has been especially prominent in industries characterized by network effects, such as the computer industry, since early lock-ins might preclude the emergence of superior technologies in these industries.   However, product pre-announcements often are not fulfilled and have been a topic of intensive discussion both in the business press and the anti-trust arena.   We have developed a simple model to analyze the effects of product pre-announcements.   In particular, we derived conditions under which such an announcement can impart valuable

---

[15] One can ask why antitrust policy cannot focus only on false claims made by the firm, allowing only truthful product pre-announcements.   However, it would be difficult to implement such a policy because of the ambiguity associated with ascertaining whether the firm actually delivered the promised quality, especially when the new features promised are something non-existent at the time of announcement. This fact makes direct contracting between the firm and consumers infeasible in the first place.

information to consumers, even if the announcement is cheap talk that does not entail any direct cost of signaling. In addition, we have investigated its welfare implications.

We find that reputational concerns can be used as an incentive device to make cheap talk *partially informative*. As a result, consumers are able to make better inter-temporal purchase decisions and are better off with product pre-announcements as long as consumers are rational and understand the incentives of low-type firms to mislead consumers. Thus, we confirm that the welfare result of Choi et al. (2004) is robust to the introduction of network effects. This is in sharp contrast to Farrell and Saloner (1986) who show that product pre-announcements may influence which product prevails in the marketplace and lead to socially inefficient technology adoption. The inefficiency in their paper arises from "stranding" of consumers who were unaware of the availability of the new product in the future and have already purchased the old product before announcement.[16] This suggests that we may need an element of "surprise" to derive inefficiencies associated with product pre-announcements, which is absent in our model.

---

[16] Their paper, however, considers only truthful pre-announcements and does not analyze the possibility of false announcements and consumers' inference problem about their informational content.

References

Bayus, B. L., S. Jain and A. G. Rao (2001), 'Truth or Consequences: An Analysis of Vaporware and New Product Announcements', *Journal of Marketing Research*, 38, 3–13.

Choi, J. P. (1994), "Irreversible Choice of Uncertain Technologies with Network Externalities," *Rand Journal of Economics*, pp. 382-401.

Choi, J. P., E. G. Kristiansen and J. Nahm (2004), "Vaporware," unpublished manuscript.

Choi, J. P., E. G. Kristiansen and J. Nahm (2005), "An Economic Analysis of Product Pre-announcements," *CESifo Economic Studies*, 2005, pp. 301-321.

Crawford, V.P. and J. Sobel (1982), "Stratgic Information Transmission," *Econometrica*, pp 1431-1451.

Dranove, D. and Gandal, N. (2003), 'The DVD vs. DIVX Standard War: Empirical Evidence of Vaporware', *Journal of Economics and Management Strategy*, 12, 2003, pp. 363–386.

Farrell, J. and G. Saloner (1986), "Installed Base and Compatibility: Innovation, Product Pre-announcements, and Predation," *American Economic Review*, 76, pp. 940–955.

Fisher, F. M., J. J. McGowan and J. E. Greenwood (1983), *Folded, Spindled, and Mutilated: Economic Analysis and U.S. vs. IBM*, MIT Press, Cambridge.

Gerlach, H. A. (2004), "Announcement, entry, and preemption when consumers have switching costs", *Rand Journal of Economics*, 35, pp. 184-202.

Haan, A. M. (2003), "Vaporware as a Means of Entry Deterrence," *Journal of Industrial Economics*, Volume LI, pp. 345-358.

Klemperer, P. (1995), "Competition when Consumers have Switching Costs," *Review of Economic Studies* (62), pp. 515-539.

Kreps, D., P. Milgrom, J. Roberts and R. Wilson (1982), "Rational Cooperation in the Finitely Repeated Prisoners' Dillemma," *Journal of Economic Theory* 27, pp. 245-52.

Levy, S. M. (1997), "Should 'Vaporware' be an Antitrust Concern?," The *Antitrust Bulletin*, pp. 33–49.

Mas-Colell, A., M. D. Whinston, and J. R.Green (1995), *Microeconomic Theory*, Oxford University Press.

Morris, S. (2001), " Political Correctness," *Journal of Political Economy*, 109, pp 231-265.

Sobel , J. (1985), "A Theory of Credibility," *Review of Economic Studies*, 52, pp. 557-573.

Appendix

The effect of product announcements on consumer welfare

In the Appendix, we analyze how the firm's product announcements affect consumer welfare in the simple two-type model with network effects. Let CS_w^H (CS_w^L) denote the total consumer surplus (for consumer 1 and 2) in each product cycle when consumer 1 waits and the firm introduces a high-quality product (low-quality product) in period 2. Similarly, we denote corresponding consumer surplus when consumer 1 does not wait and purchases the existing product in period 1 as CS_{nw}^H (CS_{nw}^L).

In our model, we have

$$CS_w^H = 2[w + \Delta + \alpha (\bar{v}_H - \underline{v}_H)]$$

$$CS_w^L = 2[w + \Delta]$$

$$CS_{nw}^H = (2w) + [w + \alpha (\bar{v}_H - \underline{v}_H) + \Delta] = 3w + \alpha (\bar{v}_H - \underline{v}_H) + \Delta$$

$$CS_{nw}^L = (2w + \Delta) + (w + \Delta) = 3w + 2\Delta$$

When the firm is allowed to make product pre-announcements, the expected total consumer welfare in the informative equilibrium is as follows:

$$W^A = W_1{}^A + \delta W_2{}^A$$

$$= (1\text{-}q)[\theta_1 CS_w^H + (1\text{-}\theta_1) \ CS_w^L] + q(\theta_2 CS_w^H + (1\text{-}\theta_2) CS_{nw}^L)$$

$$+ \delta \, [(1\text{-}q)\{\theta_1(\theta_1 CS_w^H + (1\text{-}\theta_1) \ CS_w^L) + (1\text{-}\theta_1) \ (\theta_1 CS_{nw}^H + (1\text{-}\theta_1) \ CS_{nw}^L)\} +$$

$$q\{\theta_2(\theta_2 CS_w^H + (1\text{-}\theta_2) \ CS_w^L) + (1\text{-}\theta_2) \ (\theta_2 CS_w^H + (1\text{-}\theta_2) \ CS_w^L)\}]$$

(where $W_i{}^A$ denotes total consumer welfare in product cycle i, i =1,2 when pre-announcements are allowed)

Let us analyze how prohibiting pre-announcements affects consumers' welfare. First, suppose that $q\theta_2 + (1\text{-}q)\theta_1 < \bar{\mu}$. Then, if the social planner prohibits pre-announcements, consumer 1 will buy the currently available product. In the second cycle,

consumers 1 will update her beliefs about the product's quality based on whether the product in period one is of high quality. If the firm produced a high-quality product in the first cycle, then the updated belief that the product is of high quality in the second cycle is given by $\frac{q\theta_2}{(1-q)\theta_1+q\theta_2}\theta_2+(1-\frac{q\theta_2}{(1-q)\theta_1+q\theta_2})\theta_1$. In contrast, if the firm produced a low-quality product in the first cycle, the updated belief is given by

$\frac{q(1-\theta_2)}{(1-q)(1-\theta_1)+q(1-\theta_2)}\theta_2+\frac{(1-q)(1-\theta_1)}{(1-q)(1-\theta_1)+q(1-\theta_2)}\theta_1$. By condition (5) and the fact that $\frac{q(1-\theta_2)}{(1-q)(1-\theta_1)+q(1-\theta_2)}<q$,

consumer 1 will wait for a new product in the second cycle only if the product in the first cycle is of high quality. The total expected consumer welfare is as follows:

$$W^{NA} = W_1{}^{NA} + \delta W_2{}^{NA}$$

$$= (1-q)[\theta_1 CS_{nw}^H + (1-\theta_1) CS_{nw}^L] + q(\theta_2 CS_{nw}^H + (1-\theta_2) CS_{nw}^L)$$

$$+ \delta [(1-q)\{\theta_1(\theta_1 CS_w^H +(1-\theta_1) CS_w^L) + (1-\theta_1)(\theta_1 CS_{nw}^H +(1-\theta_1) CS_{nw}^L)\} +$$

$$q\{\theta_2(\theta_2 CS_w^H +(1-\theta_2) CS_w^L) + (1-\theta_2)(\theta_2 CS_{nw}^H +(1-\theta_2) CS_{nw}^L)\}]$$

(where $W_i{}^{NA}$ denotes total consumer welfare in product cycle i, i =1,2 when pre-announcements are not allowed)

Let us compare W^A and W^{NA}. First, $W_1{}^A - W_1{}^{NA} = ((1-q)\theta_1+q\theta_2)(CS_w^H - CS_{nw}^H)$

$+(1-q)(1-\theta_1)(CS_w^L - CS_{nw}^L) = ((1-q)\theta_1+q\theta_2)[\Delta + \alpha(\bar{v}_H - \underline{v}_H) - w] - (1-q)(1-\theta_1)w$.

If we divide both sides by $(1-q+q\theta_2)$, we get $\mu_1{}^H[\Delta + \alpha(\bar{v}_H - \underline{v}_H) - w] - (1-\mu_1{}^H)w =$

$\{\mu_1{}^H[\Delta + \alpha(\bar{v}_H - \underline{v}_H) - w] - (1-\mu_1{}^H)w\}$, where $\mu_1{}^H = \frac{q\theta_2}{q\theta_2+(1-q)}+(\frac{1-q}{q\theta_2+(1-q)})\theta_1$. Since $\mu_1{}^H$

$> \bar{\mu}$, the expression in the curly bracket above is positive. We thus have that $W_1{}^A$ -

$W_1{}^{NA}>0$. Second, $W_2{}^A - W_2{}^{NA} = q(1-\theta_2)(\theta_2[\Delta + \alpha(\bar{v}_H - \underline{v}_H) - w] - (1-\theta_2) w) = q(1-$

$\theta_2)[\theta_2\{\Delta + \alpha(\bar{v}_H - \underline{v}_H) - w\} - (1-\theta_2) w]$. Since $\theta_2 > \bar{\mu}$, $W_2{}^A - W_2{}^{NA}>0$. Thus, we have

$W^A > W^{NA}$.

Second, suppose that $q\theta_2+(1-q)\theta_1> \bar{\mu}$. Then, if the firm is not allowed to make product pre- announcements, consumers will wait for a new product in the first cycle. Consumers will wait in the second cycle only if the product in the first cycle is of high

quality as in the previous case. In the second case, the expected consumer welfare can be written as follows:

$$\widetilde{W}^{NA} = \widetilde{W}_1^{NA} + \delta \widetilde{W}_2^{NA}$$
$$= (1-q)[\theta_l CS_w^H + (1-\theta_l) CS_w^L] + q(\theta_2 CS_w^H + (1-\theta_2) CS_w^L)$$
$$+ \delta [(1-q)\{\theta_l(\theta_l CS_w^H + (1-\theta_l) CS_w^L) + (1-\theta_l)(\theta_l CS_{nw}^H + (1-\theta_l) CS_{nw}^L)\} +$$
$$q\{\theta_2(\theta_2 CS_w^H + (1-\theta_2) CS_w^L) + (1-\theta_2)(\theta_2 CS_{nw}^H + (1-\theta_2) CS_{nw}^L)\}]$$

Let us compare W^A and $\widetilde{W}^{NA}$. First, $W_1^A - \widetilde{W}_1^{NA} = q(1-\theta_2)(CS_{nw}^L - CS_w^L) = w > 0$. Second, since $\widetilde{W}_2^{NA} = W_2^{NA}$, we have $W_2^A - \widetilde{W}_2^{NA} > 0$. Thus, we have $W^A > \widetilde{W}^{NA}$.

Combining these two cases, we can conclude that allowing pre-announcements always helps consumers make a better decision, and its effect on consumer welfare is positive.

The effect of product announcements on firm profit

The analysis of the effect of product announcements on the firm profit closely follows the method of proof above. When the firm is allowed to make product pre-announcements, the expected firm profit in the informative equilibrium is as follows,

$$\Pi^A = \Pi_1^A + \delta \Pi_2^A$$
$$= (1-q)[\theta_l \pi_w^H + (1-\theta_l) \pi_w^L] + q(\theta_2 \pi_w^H + (1-\theta_2)\pi_{nw}^L)$$
$$+ \delta [(1-q)\{\theta_l(\theta_l \pi_w^H + (1-\theta_l) \pi_w^L) + (1-\theta_l)(\theta_l \pi_{nw}^H + (1-\theta_l) \pi_{nw}^L)\} + q\{\theta_2(\theta_2 \pi_w^H$$
$$+(1-\theta_2) \pi_w^L) + (1-\theta_2)(\theta_2 \pi_w^H + (1-\theta_2) \pi_w^L)\}]$$

(where Π_i^A denotes firm profit in product cycle i, $i = 1,2$ when pre-announcements are allowed)

Let us analyze how prohibiting pre-announcements affects the firm profit. First, suppose that $q\theta_2 + (1-q)\theta_1 < \bar{\mu}$. By the same logic presented above, the total expected firm profit in this case can be written as follows:

$\Pi^{NA} = \Pi_1{}^{NA} + \delta \Pi_2{}^{NA}$

$= (1\text{-}q)[\theta_1 \pi_{nw}^H + (1\text{-}\theta_1) \ \pi_{nw}^L] + q(\theta_2 \pi_{nw}^H + (1\text{-}\theta_2) \ \pi_{nw}^L)$

$+ \delta \ [(1\text{-}q)\{\theta_1(\theta_1 \pi_w^H +(1\text{-}\theta_1) \ \pi_w^L) + (1\text{-}\theta_1) \ (\theta_1 \pi_{nw}^H +(1\text{-}\theta_1) \ \pi_{nw}^L)\} + q\{\theta_2(\theta_2 \pi_w^H$

$+(1\text{-}\theta_2) \ \pi_w^L) + (1\text{-}\theta_2) \ (\theta_2 \pi_{nw}^H +(1\text{-}\theta_2) \ \pi_{nw}^L)\}]$

(where $\Pi_i{}^{NA}$ denotes expected firm profit in product cycle i, $i =1,2$ when pre-announcements are not allowed)

Let us compare Π^A and Π^{NA}. First, $\Pi_1{}^A - \Pi_1{}^{NA} = ((1\text{-}q)\theta_1+q\theta_2)(\pi_w^H - \pi_{nw}^H) +(1\text{-}q)(1\text{-} \theta_1)(\pi_w^L - \pi_{nw}^L) = ((1\text{-}q)\theta_1+q\theta_2) \ [\underline{v}_H + \Delta] + (1\text{-}q)(1\text{-} \theta_1) \ (2v_L) > 0$. Second, $\Pi_2{}^A - \Pi_2{}^{NA} = q(1\text{-}\theta_2)(\theta_2[\underline{v}_H + \Delta] + (1\text{-}\theta_2) \ (2v_L) > 0$. Thus, we have $\Pi^A > \Pi^{NA}$.

Second, suppose that $q\theta_2+(1\text{-}q)\theta_1> \overline{\mu}$. Then, if the firm is not allowed to make product pre-announcements, consumer 1 will wait for a new product in the first cycle. Consumer 1 will wait in the second cycle only if the product in the first cycle is of high quality as in the previous case. In the second case, the expected firm profit can be written as follows:

$\widetilde{\Pi}{}^{NA} = \widetilde{\Pi}_1{}^{NA} + \delta \widetilde{\Pi}_2{}^{NA}$
$= (1\text{-}q)[\theta_1 \pi_w^H + (1\text{-}\theta_1) \ \pi_w^L] + q(\theta_2 \pi_w^H + (1\text{-}\theta_2) \ \pi_w^L)$

$+ \delta \ [(1\text{-}q)\{\theta_1(\theta_1 \pi_w^H +(1\text{-}\theta_1) \ \pi_w^L) + (1\text{-}\theta_1) \ (\theta_1 \pi_{nw}^H +(1\text{-}\theta_1) \ \pi_{nw}^L)\} + q\{\theta_2(\theta_2 \pi_w^H$

$+(1\text{-}\theta_2) \ \pi_w^L) + (1\text{-}\theta_2) \ (\theta_2 \pi_{nw}^H +(1\text{-}\theta_2) \ \pi_{nw}^L)\}]$

Let us compare Π^A and $\widetilde{\Pi}{}^{NA}$. $\Pi^A - \widetilde{\Pi}{}^{NA} = - q(1\text{-} \theta_2) \ (2v_L) + \delta[q(1\text{-}\theta_2)(\theta_2[\underline{v}_H + \Delta] + (1\text{-}\theta_2) \ (2v_L))] = q(1\text{-} \theta_2)[\delta\{\theta_2(\underline{v}_H + \Delta) + (1\text{-}\theta_2) \ (2v_L)\}- 2v_L] > 0$ by condition (8).

Combining these two cases, we can conclude that allowing pre-announcements also increases the ex ante firm profit.