MARKETING SCIENCE
Vol. 26, No. 1, January–February 2007, pp. 52–66
ISSN 0732-2399 | EISSN 1526-548X | 07 | 2601 | 0052

DOI 10.1287/mksc.1060.0238

Cross-Market Network Effect with Asymmetric Customer Loyalty: Implications for Competitive Advantage

Yuxin Chen
Leonard N. Stern School of Business, New York University, New York, New York 10012,
ychen@stern.nyu.edu

Jinhong Xie
Warrington College of Business Administration, University of Florida, Gainesville, Florida 32611,
Jinhong.xie@cba.ufl.edu

A *cross-market network effect* exists in many industries (e.g., newspaper publishing, media, software) in which a seller sells both a primary and a secondary product (e.g., a newspaper publisher sells newspapers to readers and advertising space to advertisers), and the value of the secondary product depends on the size of the user base of the primary product. This paper examines the competitive implications of asymmetric customer loyalty in such markets. In traditional markets, an advantage in customer loyalty generates a profit advantage. We show here, however, that in the presence of a cross-market network effect, a midlevel of loyalty advantage in the primary product market can lead to an overall profit disadvantage. This surprising result is derived from the interdependence of the two markets, whereby a profit in one market may be gained at the cost of the other, and by the positive relationship between a larger loyalty segment and a higher opportunity cost of price competition in the product of the primary market. Extending our model to a two-period entry game also shows that under certain conditions, the entrant with disadvantage in customer loyalty can outperform the incumbent in profit and market share. This result suggests that asymmetry in customer loyalty can be a source of "first-mover" advantage or disadvantage.

Key words: cross-market network effect; customer loyalty; competitive advantage; first-mover advantage; two-sided markets; newspaper industry
History: This paper was received December 19, 2002, and was with the authors 32 months for 3 revisions; processed by Chakravarthi Narasimhan.

1. Introduction

In some industries, a firm produces two different products sold in two different markets and the value of one product depends on the demand for the other. We refer to this type of dependence as a *cross-market network effect*.[1] The cross-market network effect is widespread across many different industries. For example, a newspaper publisher produces newspapers sold to readers and advertising space sold to advertisers. The value of the newspaper as a medium for advertisers to reach their potential buyers increases with its level of circulation. Consequently, the newspaper's revenue from the advertising market depends on its demand in the readers' market. The cross-market network effect is also present in the computer software industry. For example, Adobe Acrobat and RealPlayer each have two different products: a document creator targeting the content providers and a document viewer targeting the readers of the content produced by the document creator. The acceptance of a document creator by the content providers depends on the number of people who have the corresponding viewer. As mentioned in Strauss (2000), according to the U.S. Bureau of the Census (1997) (Tables 886, 903), the industries in which a cross-market network effect occurs, such as newspapers, television, radio, software, and the like, generate annual revenues of approximately $200 billion in the United States alone.

Despite the ubiquitous existence of the cross-market network effect, little work has been done to examine

[1] Strauss (2000) uses the term "cross-market network externalities." We use "cross-market network effect" because, in economics, externalities are typically associated with the potential of market failure, which is not true in our context. In IS literature, the term "two-sided markets" is also used to describe the similar phenomenon (Parker and Van Alstyne 2005, Rochet and Tirole 2003).

its impact on firms' business strategies, with the exception of a few recent studies (Chaudhri 1998, Strauss 2000, Godes et al. 2003, Cabral and Villas-Boas 2005). In studying the pricing policies of a monopoly newspaper publisher, Chaudhri (1998) suggests that it can be optimal for the monopolist to lower the newspaper price even below its marginal cost in order to increase its circulation and thus obtain higher advertising revenue. Strauss (2000) asserts that the existence of a cross-market network effect affects the optimal prices of the two interdependent products in opposite directions: the stronger the cross-market network effect, the larger the difference in profit margins between the two products. He also shows that increased product compatibility among firms leads to increased profit. Godes et al. (2003) examine the relative source of profits from the audience market versus advertising market for media firms. They show that a firm's decision to become an advertising medium depends on both the within-industry and the between-industry competition of the firms in the two markets. Cabral and Villas-Boas (2005) study oligopoly price competition between multi-product firms whose products interact in their profit functions through either demand externalities or cost externalities.[2] They find that a "Bertrand supertrap" can occur, whereby the strategic effect of competition on firms' profits by an economic force may dominate its direct effect on profit that applies to a monopoly firm. They show, for example, that stronger economies of scope may lead to lower profitability for firms in competition if their products interact in profit functions.

Although the studies mentioned above provide important insights into the behavior of firms in markets with a cross-market network effect, no studies to date have addressed the question of how asymmetry in customer loyalty may affect firms' competitive strategies in the presence of a cross-market network effect. However, in reality, competing firms in an industry are more likely to be asymmetric in their customer loyalty, as a result of differences in product positioning, marketing effectiveness, and order-of-entry of the firms. In general, an incumbent in an industry is more likely to enjoy higher customer loyalty than a potential entrant (Carpenter and Nakamoto 1989). Therefore, examining the impact of asymmetry loyalty is also important in understanding firms' entry strategies. In markets with a cross-market network effect, the issue of asymmetry in customer loyalty is particularly interesting because firms in such markets face competition in multiple interdependent markets so that the installed user base and customer loyalty in one market affect competition not only in that market but in other markets as well. Moreover, loyalty build-up is especially important among industries characterized by the cross-market network effect because consumer commitments (e.g., in subscription-based industries such as newspapers and cable TV) and switching costs (e.g., the sizeable learning costs to become familiar with functions of a software package such as Windows Media Player) play very significant roles in competition. Finally, understanding the competitive implications of asymmetry loyalty is practically relevant for industries characterized by the cross-market network effect as they are witnessing the entry of new players. For example, established newspapers are now facing increasing competition from the entry of free newspapers such as *Metro* and *amNew York* (Carvajal 2004). The growing popularity of blogs also imposes challenge to the traditional media companies (*Business Week* 2005).

In this paper, we examine the impact of a cross-market network effect on firms' competitive strategies, paying special attention to the interaction between the cross-market network effect and asymmetry in customer loyalty. Specifically, we address the following question: All else being equal, does higher customer loyalty always lead to higher profit and market share for a firm with more loyal customers than its rival in industries with a cross-market network effect? Previous literature has suggested a positive effect of customer loyalty on a firm's competitive advantage (Narasimhan 1988). We examine whether or not this conclusion is still true in the presence of a cross-market network effect.

To address the research question, we have developed a model composed of two competing firms, each selling two products (a primary and a secondary product) in two markets with a cross-market network effect: i.e., the value of the secondary product depends on the demand for the primary product. The firms differ in customer loyalty in the market of the primary product with one firm having more loyal customers than the other. Our analysis reveals that, under certain conditions, loyalty advantage can surprisingly lead to both profit and market share *disadvantage* in markets with a cross-market network effect. Specifically, we show that a high or low loyalty advantage in the market of the primary product allows a firm to gain a higher total profit than the firm with disadvantage in customer loyalty. However, a mid-range loyalty advantage in the market of the primary product may lead to a lower total profit for the firm compared with its competitor. A firm with a mid-range loyalty advantage has an incentive to set a high price to target its loyal segment, because its loyalty advantage

[2] The cross-market network effect can be viewed as one type of such externalities. Such externalities may also include other types of cross-market interaction, e.g., the price interaction of different brands across different geographic markets (Chintagunta and Desiraju 2005).

is quite significant and the existence of a price lower bound limits its ability to obtain non-loyal customers by further undercutting the competitor in price. As a result, this can lead to a disadvantage in market share in the primary product market if the firm's customer loyalty advantage is not high enough to outnumber the non-loyal customers attracted by its competitor. Consequently, its profit from the secondary product can be lower than that of its competitor, and its total profit from both markets can also be lower than that of its competitor. Therefore, it is possible for the firm with disadvantage in customer loyalty to achieve a higher market share and profit than the firm with a loyalty advantage.

To examine the implications of this finding on firms' entry strategy and the first-mover's advantage and disadvantage in markets with the cross-market network effect, we extend our model to a two-period entry game. We further show that when the fixed cost of entry is small, an entrant with no loyal customer base at entry may obtain higher profit than the incumbent. This is due to the fact that the incumbent is most vulnerable with a mid-sized loyal customer base, while profit for the entrant is highest in such a situation.

This result complements previous research on entry (Lilien and Yoon 1990, Narasimhan and Zhang 2000) and first-mover advantage. Lieberman and Montgomery (1988) suggest that the first mover in a product category can enjoy an advantage over later comers. However, empirical evidence is mixed (Glazer 1985, Robinson and Fornell 1985, Robinson 1988, Golder and Tellis 1993, Kalyanaram et al. 1995).[3] This paper suggests a new source of first-mover advantage or disadvantage. As shown by our model, in the presence of a cross-market network effect, a first mover has an advantage over an entrant if its loyalty base in the market of the primary product is either small or large. However, a first mover may be at a disadvantage to the entrant in terms of profitability if its loyalty base is in the midlevel range.

It is worth noting that the findings reported in this paper result from the unique features of a cross-market network effect, which are profoundly different from the direct and indirect network effects studied extensively in the marketing and economics literature.[4] A cross-market network effect has two basic characteristics: (1) firms provide multiple products to different sets of customers; and (2) the value of one product depends on the demand for the other products. In markets with a direct network effect (e.g., fax machines), the main concern of potential buyers of a product is the user base of the same product. However, in markets with a cross-market network effect, the main concern of the potential buyers of one product (e.g., advertisers in the newspaper industry) is the user base of the other products (e.g., circulation of the newspaper). Interaction between different products (e.g., hardware and software) also exists in markets with an indirect network effect in which different products are usually made by different firms but are sold to the same customers. However, in markets with a cross-market network effect, different products are produced by the same firm but are sold to different customers.

The remainder of this paper is organized as follows. In §2, we present our basic model, derive the key theoretical results, and provide three predictions. In §3, we examine some of the predictions using data from the newspaper industry. In §4, we discuss the robustness of our main results, derive the implication of loyalty asymmetry on market entry strategy and first-mover's advantage/disadvantage, and conclude the paper.

2. The Model

In this section, we start with a simple model to examine the competitive implications of asymmetric customer loyalty in a market characterized by a cross-market network effect. Our objective is to first use a simple model to capture the essence of the cross-market network effect and the key economic insights to be shown in the paper without introducing unnecessary mathematical complexity. In §4, we examine the robustness of our results derived from this basic model by relaxing some of the assumptions. Notations used in our theoretical models are summarized in the Table of Notations (see the appendix). Proofs of the theoretical results are also given in the appendix.

2.1. Assumptions

We consider two competing firms that differ in customer loyalty, i.e., a high- and a low-loyalty firm ($i = H, L$). Both firms sell two different, but related, products: a primary product and a secondary product ($j = P, S$). The market of the primary product has a size of one (1) and consists of two customer segments: (a) a segment of customers of size θ ($0 < \theta < 1$), who are loyal to firm H, and (b) a segment of customers of size $1-\theta$, who are loyal to neither firm. The

[3] Another paper relating to this literature is Pauwels and Srinivasan (2004), which examines the impact of store brand entry on the performance of the incumbent brands. A recent review paper (Soberman and Gatignon 2005) calls for more research on the factors determining the degree to which a market will be dominated by a first mover.

[4] For example, Katz and Shapiro (1985), Farrell and Saloner (1986), Church and Gandal (1992, 1993), Xie and Sirbu (1995), Padmanabhan et al. (1997), Gupta et al. (1999), Ofek and Sarvary (2001), Shankar and Bayus (2003), Basu et al. (2003), Srinivasan et al. (2004), Sun et al. (2004), Harikesh et al. (2004), Chakravarti and Xie (2006), and Wang and Xie (2006).

loyalty difference can stem from a variety of sources or factors. For example, in the newspaper industry, such loyalty difference can be due to quality of editorial/commentary, topic coverage, and political inclination (i.e., conservative versus liberal).[5] In addition, loyalty can also be related to customer satisfaction (Mittal et al. 2005).

Each consumer has a unit demand in the primary product market. Let k and s denote the reservation price of the loyal and non-loyal customers, respectively, where $s \le k$. Denote p_{iP} as firm i's price in the market of the primary product. Loyal customers buy only from firm H, provided that $p_{HP} \le k$. Non-loyal customers (i.e., switchers) buy from the firm that offers a lower price for the primary product provided that such price is not higher than s. If two firms set the same price, switchers buy from each firm with a probability of 50%. We assume $s = 0$ in the basic model and relax this assumption later in §4. The marginal cost of production of each firm in the primary market is c, where $k > c$.

To capture the cross-market network effect, we assume that firm i's profit from the secondary product market is $\pi_{iS} = hD_{iP}$, where D_{iP} is firm i's demand in the primary product market and $h > 0$ captures the strength of the cross-market network effect. This profit specification assumes that a firm's profit from the secondary product is derived solely from the demand for its primary product. A similar assumption is used by Chaudhri (1998) to model the circulation industry (e.g., newspapers). Because our empirical investigation uses data from the newspaper industry, we take an additional step of providing a formal justification for this profit specification in the context of the circulation industry in Appendix A.1.

Our model assumes a cross-market network effect from the primary to the secondary product, but not vice versa. The rationale behind this assumption is that in many circumstances (e.g., the newspaper industry), the cross-market network effect in one direction dominates the other. As demonstrated by Strauss (2000), it is analytically sufficient to consider only the "net" effect of a bi-directional cross-market network effect.

Finally, we assume that neither firm will charge a price below a lower bound, $p_0 \le 0$. We first assume $p_0 = 0$ and relax this assumption later in §4. Generally, a price less than zero could not be optimal because it would be equivalent to giving money away, even to those who have nothing to do with the product (Strauss 2000 and Chaudhri 1998).[6] For example, if a newspaper publisher pays people to receive copies of the newspaper, those who do not want to read the newspaper can take the copies, receive the money, and dispose of the newspaper without paying attention to the contents and ads. As a result, the circulation generated from such demand will not provide value to advertisers. Therefore, unless a firm can enforce the desirable behavior of customers (e.g., actually reading the newspaper) at a negative price, setting a price below zero will not be optimal. Our assumption of a lower bound price is also consistent with industry practice. For example, the Audit Bureau of Circulations does not count any newspaper sold under 75% of its listed price (e.g., give-away copies in hotel rooms) as circulation that can be used to negotiate rates with advertisers. In addition, the publishers have to report the circulation figures for copies sold at discount separately from those sold at full price. Under these rules, deep discounting has been used "sparingly if at all" (*Editor & Publisher* 2002) because the reported discounted sales are not "going to look good" (*The Wall Street Journal* 2001) because they may not constitute the circulation market in which advertisers are interested.

2.2. Equilibrium

We can see that, for firm H, the optimal price of the primary product is either $p_{HP} = k$ or $p_{HP} = 0$. Similarly, for firm L the optimal price of the primary product is $p_{LP} = 0$.[7] The two competing firms set prices simultaneously in the market of the primary product. firm i's profit can be written as

$$\pi_i = D_{iP}(p_{iP} - c) + hD_{iP}. \tag{1}$$

$$\begin{cases} D_{HP} = \theta, \quad D_{LP} = 1-\theta & \text{if } p_{HP} = k \\ D_{HP} = \theta + 0.5(1-\theta), \quad D_{LP} = 0.5(1-\theta) & \\ & \text{if } p_{HP} = 0. \end{cases} \tag{2}$$

Firms' total profits are given in (3):

$$\begin{aligned} \pi_H &= \begin{cases} (k-c)\theta + h\theta & \text{if } p_{HP} = k \\ 0.5(1+\theta)(h-c) & \text{if } p_{HP} = 0, \end{cases} \\ \pi_L &= \begin{cases} (h-c)(1-\theta) & \text{if } p_{HP} = k \\ 0.5(1-\theta)(h-c) & \text{if } p_{HP} = 0. \end{cases} \end{aligned} \tag{3}$$

[5] Note that as commented by Wernerfelt (1991), "While the concept of brand loyalty has been used extensively in the marketing literature, the field has not reached consensus on a single definition." Our definition of loyalty is consistent with Narasimhan (1988), Chen et al. (2001), and segmentation literature where loyalty is defined by consumer preference.

[6] In some cases, a negative price is possible. For example, local radio stations sometimes offer a number of prizes to listeners to keep them listening. We thank an anonymous reviewer for pointing out this fact. The feasibility of such negative prices is critically dependent upon the ability of firms to ensure the real consumption of the primary product (e.g., ensuring that customers receiving the prizes actually listen to the radio).

[7] For example, in the plug-in software industry, many firms give away their primary product (e.g., Adobe Viewers). Free newspapers such as *Metro* and *amNewYork* are also gaining popularity (Carvajal 2004).

If $h \le c$, firm H will set price at k with $\pi_H = (k-c)\cdot\theta + h\theta$, but firm L cannot make any profit. In the following discussion, we assume $h > c$ so that both firms participate in the competition. The equilibrium results under $h > c$ are provided in Lemma 1.

Lemma 1 (Equilibrium). *Firms' equilibrium price, demand, and profit are given in Table* 1.

As shown in Lemma 1, firm L always sets its price at zero because it has no loyal customers. Firm H's optimal price is determined by the trade-off between the profit from the primary and the secondary product because a higher price leads to a higher profit margin but a lower demand from the primary product, which in turn reduces its profit from the secondary product due to the cross-market network effect. It is optimal for firm H to adopt a high price only if the size of the loyal segment for its primary product is sufficiently large, so that the amount firm H gains by charging a high price to the loyal customers of its primary product is sufficient to compensate for its loss from the secondary market resulting from its small share in the primary product market. We call the high-price and low-price strategies "primary-product-driven" and "secondary-product-driven" strategies, respectively, because the former focuses on profit of the primary product and the latter focuses on profit of the secondary product.

Lemma 1 suggests that, as loyalty varies more dramatically across competing firms, ($\theta > \underline{\theta}$), firms move from symmetric (i.e., both pursue a secondary-product-driven strategy) to asymmetric strategies (H becomes primary-product-driven but L remains secondary-product-driven). Furthermore, as shown in Lemma 1, $d\underline{\theta}/h > 0$ and $d\underline{\theta}/k < 0$, which imply that the asymmetry in pricing strategy is more likely (i.e., $\underline{\theta}$ is smaller) when the advertising market is less attractive (i.e., when h is smaller) or when the loyalty premium is higher (i.e., when k is larger).

2.3. Profit

We now look at the implications of asymmetric customer loyalty for firms' profits in the presence of a cross-market network effect. While Lemma 1 presents firms' equilibrium profits, Proposition 1 formally states the conditions under which each firm has a profit advantage.

Proposition 1 (Impact of Loyalty Advantage on Profit). *A loyalty advantage leads to a profit* disadvantage *when two conditions hold*: (1) *a mid-range cross-market network effect; and* (2) *a mid-range loyalty advantage. Otherwise, a loyalty advantage always leads to a profit advantage. Mathematically,*

$$\begin{cases} \pi_H < \pi_L & \text{if } \underline{h} < h < \bar{h} \text{ and } \underline{\theta} < \theta < \bar{\theta} \\ \pi_H \ge \pi_L & \text{otherwise,} \end{cases}$$

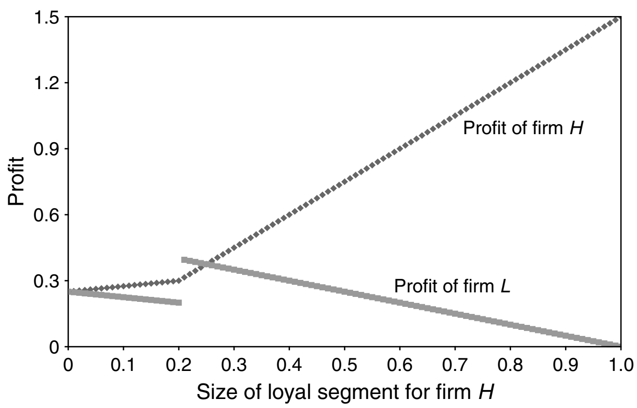
$$\text{where}\begin{cases} \underline{h} = c & \bar{h} = k + c \\ \underline{\theta} = \dfrac{h-c}{2k+h-c} & \bar{\theta} = \dfrac{h-c}{k+2(h-c)}. \end{cases} \tag{4}$$

Proposition 1 reveals an interesting but counterintuitive result: A loyalty advantage can lead to a profit disadvantage. Figure 1 graphically illustrates this result. As shown in Figure 1, although firm L's profit decreases within both regions, $(0, \underline{\theta})$ and $(\underline{\theta}, 1)$, it increases at $\theta = \underline{\theta}$. The increase in firm L's profit at $\theta = \underline{\theta}$ leads to a dramatic change in the firms' relative profits, i.e., firm H loses its profit advantage and firm L becomes the profit leader. The reason for this dramatic change is that, when the size of the loyal segment increases, a secondary-product-driven strategy is less profitable and a primary-product-driven strategy is more profitable for firm H. The two strategies bring firm H the same profit at $\theta = \underline{\theta}$. However, when firm H switches to a primary-product-driven strategy at $\theta = \underline{\theta}$, firm L's customer base increases

Table 1 Equilibrium Results for Lemma 1

	Asymmetry in customer loyalty: $\theta \le \underline{\theta} = (h-c)/(2k+h-c)$	Asymmetry in customer loyalty: $\theta > \underline{\theta} = (h-c)/(2k+h-c)$
Price (primary product)	$\begin{cases} p^*_{HP} = 0 \\ p^*_{LP} = 0 \end{cases}$	$\begin{cases} p^*_{HP} = k \\ p^*_{LP} = 0 \end{cases}$
Market share (primary product)	$\begin{cases} D^*_{HP} = \theta + 0.5(1-\theta) \\ D^*_{LP} = 0.5(1-\theta) \end{cases}$	$\begin{cases} D^*_{HP} = \theta \\ D^*_{LP} = (1-\theta) \end{cases}$
Total profit	$\begin{cases} \pi^*_H = 0.5(1+\theta)(h-c) \\ \pi^*_L = 0.5(1-\theta)(h-c) \end{cases}$	$\begin{cases} \pi^*_H = (k-c)\theta + h\theta \\ \pi^*_L = (h-c)(1-\theta) \end{cases}$
Comparisons	$\begin{cases} \Delta MS_P = D_{HP} - D_{LP} = \theta \\ \Delta\pi = \pi_H - \pi_L = (h-c)\theta \end{cases}$	$\begin{cases} \Delta MS_P = D_{HP} - D_{LP} = 2\theta - 1 \\ \Delta\pi = \pi_H - \pi_L = [k+2(h-c)]\theta - (h-c) \end{cases}$

Figure 1 **Profits of Competing Firms**



Note. $k = 1$, $h = 0.5$.

substantially because firm H gives up the non-loyal customers. This increased customer base, in turn, significantly increases firm L's profit from the secondary market and results in a profit advantage over firm H.

When a profit-reversal situation occurs, a question arises: Will firm H have an incentive to price lower than firm L in order to obtain a higher demand in the primary market? The answer is no, for two reasons: First, firm L can always compete more aggressively because it has a lower opportunity cost of losing margin from its loyal customers. Therefore, any effort to cut prices by firm H will be countered by firm L. Second, the existence of a lower bound of price, p_0, in the primary market also discourages firm H from further undercutting the rival firm's price. This is because, at a negative price below p_0, a firm starts to give away money to customers. Unless a firm can enforce the desirable behavior of customers at such a price (e.g., actually reading the newspaper, paying attention to the radio station, using the computer software), a negative price will bring in a large number of irrelevant customers in the primary market who do not provide value to the customers in the secondary market. Consequently, the firm will lose profit at prices below p_0. This fact prevents firms from endlessly undercutting each other's prices. It is worth noting that this feature of pricing consideration is closely related to the nature of the cross-market network effect. In essence, the cross-market network effect exists because the actions (e.g., attention, usage) of the customers in the primary market affect the utility of the customers in the secondary market. Merely paying customers to receive the product is unlikely to bring desirable actions from those customers in the primary market unless proper monitoring and enforcing methods are in place.

Figure 1 also shows that, for $\theta > \underline{\theta}$, firm H's profit increases and firm L's profit decreases with θ. As a result, firm L's profit advantage decreases and finally disappears at $\theta = \bar{\theta}$. Hence, firm L will have a profit advantage over firm H only when firm H's loyalty advantage falls into the loyalty window, $[\underline{\theta}, \bar{\theta}]$.

Note that the existence of a loyalty window depends on the relative magnitude of both the cross-market network effect (h) and the loyalty premium (k). The size of the loyalty window for firm L to obtain a profit advantage is $l(\theta) = \bar{\theta} - \underline{\theta} = (h - c) \cdot (k - h + c)/((k + 2h - 2c)(2k + h - c))$,[8] which is positive only for markets with a mid-range cross-network effect, $c < h < k + c$. Thus, an opportunity loyalty window that would allow firm L to outperform firm H does not exist if the cross-market network effect is too weak or too strong. In the case of a very weak cross-market network effect, the user base of a primary product has little impact on the value of the secondary product. As in the markets without a cross-market network effect, an advantage in customer loyalty always leads to a profit advantage. In the case of an overwhelmingly strong cross-market network effect, the user base of the primary product is too valuable for firm H to give up the non-loyal customers in the primary market. Consequently, firm L cannot establish a large user base for the primary product.

Finally, it is worth mentioning that Proposition 1 by no means downplays the importance of obtaining high customer loyalty. This is because while firms' relative profit depends on whether or not θ is in the mid-range, firm H's absolute profit always increases with the size of its loyal customer segment regardless of whether it adopts a primary-product-driven strategy (i.e., when $\theta \in (0, \underline{\theta})$) or a secondary-product-driven strategy (i.e., when $\theta \in (\underline{\theta}, 1)$). Therefore, as shown in Figure 1, firm H always benefits from higher customer loyalty.

2.4. Market Share

It is also interesting to examine the impact of asymmetry in customer loyalty on firms' market shares in the primary product market. Because the size of this market is normalized to one in our model, the market share of firm i in the primary product market is equal to D_{iP}. Proposition 2 follows.

Proposition 2 (Impact of Loyalty Advantage on Market Share). *A loyalty advantage leads to a market share* disadvantage *when two conditions hold*: (1) *a mid-range cross-market network effect*; *and* (2) *a mid-range loyalty advantage*. *Otherwise*, *a loyalty advantage always leads to a market share advantage*. *Mathematically*,

$$\begin{cases} D_{HP} < D_{LP} & \text{if } \underline{h} < h < \bar{\bar{h}} \text{ and } \underline{\theta} < \theta < \bar{\bar{\theta}} \\ D_{HP} \geq D_{LP} & \text{otherwise,} \end{cases}$$

[8] The maximum $l(\theta)$ is about 0.057 occurring at $k = 1 + 3\sqrt{2}/2$. In the extension to be discussed in §4.1, the maximum $l(\theta)$ can be as large as $2/7 \approx 0.286$.

$$\text{where}\quad \begin{cases} \underline{h} = c, \quad \bar{\bar{h}} = 2k + c \\ \underline{\theta} = \dfrac{h-c}{2k+h-c}, \quad \bar{\bar{\theta}} = \dfrac{1}{2}. \end{cases} \tag{5}$$

Proposition 2 shows that, similar to the loyalty window for firm L to obtain a higher profit than firm H, there exists a loyalty window, $[\underline{\theta}, \bar{\bar{\theta}}]$, for firm L to obtain a higher market share than firm H. Note that $\bar{\bar{h}}$ and $\bar{\bar{\theta}}$ given in Proposition 2 are higher than $\bar{h}$ and $\bar{\theta}$ given in Proposition 1 ($\bar{\bar{h}} > \bar{h}$, $\bar{\bar{\theta}} > \bar{\theta}$). This implies that the window for firm L's market share advantage is wider than that for its profit advantage. Hence, if firm H loses its advantage in profit, it also loses its potential advantage in market share. However, firm L's market share advantage does not guarantee its profit advantage.

2.5. Predictions

The above lemma and propositions suggest that, in the presence of a cross-market network effect, asymmetry in customer loyalty affects firms' competitive strategies and their relative advantages in market share and profit. Specifically, our theoretical findings lead to the following three predictions:

- P1 (*Pricing Strategy*): In a market with a cross-market network effect, sufficient asymmetry in customer loyalty leads to asymmetry in pricing strategy. Specifically, (a) when neither firm has a large loyalty base, both pursue a secondary-product-driven strategy, (b) when one firm has a sufficient loyalty advantage, the firm with loyalty advantage pursues a primary-product-driven strategy, but the firm with loyalty disadvantage pursues a secondary-product-driven strategy.
- P2 (*Market Share*): In a market with a cross-market network effect, the impact of loyalty on a firm's market share advantage in the primary product market is non-monotonic. Specifically, the market share advantage generated from a loyalty advantage can be less under a mid-range loyalty advantage than under a small or large loyalty advantage. It is even possible that a mid-range loyalty advantage results in a market share disadvantage.
- P3 (*Profit*): In a market with a cross-market network effect, the impact of loyalty on a firm's overall profit advantage from both the primary and the secondary product market is non-monotonic. Specifically, the profit advantage generated from a loyalty advantage (in the primary product market) can be less under a mid-range loyalty advantage than under a small or large loyalty advantage. It is possible that a mid-range loyalty advantage results in a profit disadvantage.

In the next section, we provide some empirical evidence gathered from the newspaper industry to examine our model predictions. The recent anecdotal evidence from the newspaper industry indicates a noticeable trend of the growing popularity of free newspapers, such as *Metro* and *amNew York* (Carvajal 2004, *Crain's New York Business* 2005). This trend has imposed pressure on more established newspapers such as Murdoch's *Sun* in the United Kingdom (*The Guardian* 2005a). Interestingly, facing this trend, the *New York Times* has started to charge for its online content that formerly was free (*The Guardian* 2005b).

3. Empirical Evidence

To provide some empirical evidence for the external validity of our main theoretical results, we use data collected from the newspaper industry to examine some of our predictions. Notations used in our empirical analysis are summarized in the Table of Notations in the appendix.

3.1. Data and Measurement

We collected data from the *Ayer Directory of Publications* (ADP) (1973–1982), an annual listing by town/city of all local newspapers in the United States, published by Ayer & Son, Inc. The period from 1973 to 1982 was chosen because it was the only period for which ADP was available to us for consecutive years. ADP lists the dates on which a newspaper began and ceased publication. It also provides information on subscription rates, circulation, and advertising rates for the many newspapers it lists.

Because the data do not provide direct measures of the sizes of firms' loyalty segments, we focus on towns/cities with two competing newspapers that entered the market at different times. For those towns/cities, we can reasonably assume that the newspaper that entered earlier had a loyalty advantage at the time when the later comer entered the market. Our samples included all towns/cities in the United States that satisfied the following three criteria: (1) at least one of the two newspapers entered the market between 1974 and 1979; (2) data on circulation, subscriber rates, and advertising rates were reported in the ADP; and (3) neither newspaper exited the market within the first three years after entry. A total of twenty-two cases satisfied these criteria within the period examined. In order to satisfy the last criterion, we did not use data from 1980 to 1982. Data from 1973 were used to measure pre-entry conditions if applicable.

Let $j = 1, 2, \ldots, 22$ denote the incumbents (H firms) and $j = 23, 24, \ldots, 44$ denote the entrants (L firms). Let $T = -1, 0, 1$ denote the year before entry, the year of entry, and the year after the entrant entered the market. A summary of our data is provided in Table 2. The following variables were used in our analysis:

Table 2 Data Summary

	Incumbent ($N=22$)			Entrant ($N=22$)	
	$T=-1$	$T=0$	$T=1$	$T=0$	$T=1$
Circulation*	15,238 (19,461)	15,711 (20,212)	15,605 (20,574)	8,055 (6,875)	8,001 (5,826)
Subscription rate ($)**	0.12 (0.04)	0.13 (0.05)	0.14 (0.05)	0.08 (0.07)	0.10 (0.09)
Advertising rate ($)***	0.17 (0.08)	0.18 (0.09)	0.21 (0.10)	0.19 (0.10)	0.19 (0.10)
Geographic information	Total number of states: 12 Total number of town/cities: 22 Name of the states (number of town/cities): California (3), Colorado (2), Florida (2), Georgia (3), Illinois (4), Kansas (1), Nevada (1), New Jersey (1), New York (1), North Carolina (1), Pennsylvania (1), Texas (2)				

Note. The numbers in parenthesis are standard deviations. $T-1$, T, and $T+1$ are the year before the entry, at the entry, and after entry.

*Circulation statements obtained from the publisher are for the latest date possible and generally represent an average circulation for six months preceding the compilation of the directory in which they appear.

**Subscription rate is the per issue rate.

***Black and white general line rates.

Subscription Rate. The subscription rates reported by ADP were annual fees paid by local subscribers. We converted the reported subscription rate to subscription rate per issue. We denote the subscription rate for firm j at time T as $SR(T)_j$.

Advertising Rate. The advertising rates reported by ADP were black and white general line rates. The advertising rate for firm j at time t is denoted as $AR(T)_j$.

Circulation. The circulation data reported by ADP were obtained from publishers that "generally represent an average circulation for six months preceding the compilation of the directory in which they appear." We denote firm j's circulation at time T as $C(T)_j$.

Market Share of Circulation. To facilitate the cross-sectional comparison of the circulation levels, we define the market share of circulation of firm j at time t ($T=-1, 0, 1$) as $MS(T)_j = C(T)_j/C(1)$,[9] where $C(1)$ is the total circulation of the two competing newspapers after the entry of the second firm.

Incumbent's Penetration Level at Entry. We define the penetration level of incumbent j at the time of entry as $IP_j = MS(0)_j$. Because data on the size of the incumbent firms' loyal followings were not available to us, we use IP_j as a proxy measure of the size of the loyal segment of incumbent j. This choice implicitly assumes that there exists a monotonic relation between the number of an incumbent's loyal subscribers at the time of entry and IP_j.

3.2. Analysis and Results

Because data on firms' profits were not available, we focused on pricing strategies and market shares.

Existence of Cross-Market Network Effect. First, we verify the existence of a cross-market network effect in our data. We ran simple regressions both before ($T=-1$) and after entries occurred ($T=1$):

$$\begin{cases} AR(-1)_j=\alpha_{-1}+h_{-1}C(-1)_j+\varepsilon_j & j=1,2,\ldots,22 \\ AR(1)_j=\alpha_1+h_1C(1)_j+\varepsilon_j & j=1,2,\ldots,44. \end{cases} \tag{6}$$

The regression results are given in Table 3. Circulation alone explains 42% and 24% of variances in advertising rate for the pre-entry monopoly market ($T=-1$) and post-entry competitive market ($T=1$), respectively. Given that advertising rates are also affected by many other factors not considered in the models (i.e., the quality of the newspapers and the type of readers), the regression results are satisfactory. Table 3 shows that circulation has a significant positive effect on advertising rate ($p<0.001$) in both monopoly and duopoly markets, confirming the existence of a cross-market network effect in our data. It is also interesting to note from Table 3 that the strength of the cross-market network effect, h, is about the same in both pre-entry and post-entry markets ($h=0.003$).

Impact of Loyalty on Pricing Strategy (*Subscription Rate*). Based on P1, we expect that the difference in post-entry subscription rate between the incumbent

Table 3 Regression Results: Existence of Cross-Market Network Effect

	Dependent variable = advertising rate ($)	
	$T=-1$ (Monopoly)	$T=1$ (Competition)
Constant	0.128 (0.000)*	0.160 (0.000)
Circulation (000)	0.003 (0.001)	0.003 (0.001)
R^2	0.42	0.24

*The numbers in parentheses are the p-values in two-tail test.

[9] More precisely, $MS(-1)$ should be interpreted as the incumbent's market coverage since it is a monopolist at $T=-1$.

and the entrant is *not* significant when the incumbent's penetration level at the time of entry is small, but is *positive* when such a penetration level is large. To test this, we define $\Delta SR_j = (SR_j(1) - SR_{j+22}(1))/SR_j(1)$ to measure the difference in the post-entry subscription rate between incumbent j and the corresponding entrant. We then divide the sample into two groups based on the median-split of IP_j. Each group consists of 11 incumbents. In the group where IP_j is low ($IP_j < 0.6$), the mean of ΔSR_j is -0.13 with standard error 0.66. As expected, the mean of ΔSR_j in this group is not significantly different from 0 ($p > 0.85$ in a two-tail test). In the other group, where IP_j is high ($IP_j > 0.6$), the mean of ΔSR_j is 0.37 with standard error 0.15. The mean of ΔSR_j in this group is significantly larger than 0 ($p < 0.02$ in a one-tail test). This result is consistent with our prediction on the impact of loyalty on pricing strategy. Note that it is possible that there are other forces that may also drive such a price pattern. For example, when the incumbent's penetration level at the time of entry is large, the entry may have a higher need to offer price break to general trial since the quality of the new newspaper is unknown and the incumbent has established a large reader base.

Impact of Loyalty on the Market Share. P2 suggests that the loyalty advantage has a positive effect on market share advantage, but this relationship is not linear. Our theoretical results given in Lemma 1 specify how ΔMS changes with θ in two regions: a small loyalty difference, $\theta < \underline{\theta}$, and a large loyalty difference, $\theta > \underline{\theta}$. The functional forms of ΔMS with regard to θ in Lemma 1 suggest that ΔMS increases with θ in both regions but decreases at $\theta = \underline{\theta}$. This functional form implies that ΔMS can be smaller when θ is in a middle range than when θ is small or large. To test this, our data analysis focuses on the relationship between ΔMS (the market share difference between the incumbent and the entrant) and IP (the incumbent's penetration level at entry) in two regions, with high and low values of IP, respectively. Specifically, we examine if ΔMS increases with IP in both regions, but decreases with IP at the border of the two regions. The observations are sorted so that IP_j is in ascending order. Let J denote the cutoff level between a high ($j > J$) and low ($j \leq J$) penetration level for the incumbent at the time of entry. Define D_j as a dummy variable such that $D_j = 1$ if $j > J$ and $D_j = 0$ otherwise. The regression (7) is used:

$$\Delta MS_j = \beta_0 + \beta_1 D_j + \beta_2 IP_j + \beta_2 D_j IP_j + \varepsilon_j, \qquad (7)$$

where $\Delta MS_j = MS(1)_j - MS(1)_{j+22}$ is the difference between the incumbent's market share and the entrant's market share after the entry. To determine the cutoff level J, we empirically tested different cutoff levels, $J = 0, 1, \ldots, 22$, and chose the one that maximizes the adjusted R-squared of the regression model (7).

Table 4 **Regression Results: Change in Market Share***

Dependent variable $= \Delta MS_j$, where $\Delta MS_j = MS(1)_j - MS(1)_{j+22}$
$D_i = 1$ if $j > J$ and $D_j = 0$ otherwise.

Constant	-0.866 (0.000)**
D_j	-1.584 (0.009)
IP_j	1.728 (0.000)
$D_j IP_j$	1.946 (0.011)
Adjusted R-square (maximized at $J = 13$)	0.929

*The results reported are for $J = 13$.
**The numbers in parentheses are the p-values in two-tail test.

The results of estimations are given in Table 4 ($J = 13$, Adjusted R-square $= 0.929$). Two regions are identified, with 13 and nine observations, respectively. All coefficients are significant ($p < 0.011$, a two-tail test). In the data, we have $\Delta MS_{13} = 0.327$ (with $IP_{13} = 0.663$) but $\Delta MS_{14} = -0.095$ (with $IP_{14} = 0.709$). This is consistent with P2. Using the estimated coefficients (see Table 4), the relationship between ΔMS and IP can be written as $\Delta MS_j = -0.866 + 1.728 IP_j$ for $j \leq 13$ and $\Delta MS_j = -2.450 + 3.674 IP_j$ for $j > 13$. As expected by P2, the predicted ΔMS increases with IP in both regions, but decreases at the border of the two regions (i.e., $\Delta MS_{14} < \Delta MS_{13}$).[10] In addition, we can see that the coefficient of IP_j is higher (3.674) for $j > 13$ than for $j \leq 13$ (1.728). This is also consistent with the results reported in Lemma 1.

4. Discussion and Conclusions

4.1. Robustness of Main Findings

To examine the robustness of our main findings, we relax several simplified assumptions in our basic model by allowing (a) a positive reservation price for switchers, $k \geq s > 0$; (b) both firms to have loyal customers; (c) a less restrictive lower bound of firms' prices (p_0 can be negative); and (d) three different competitive structures in the primary product market (i.e., a simultaneous-move game, an H-led sequential-move game, and an L-led sequential-move game). The key findings derived from the basic model still hold under these more general conditions (see a technical appendix available on the Website of this journal for detail proofs).

The basic model uses a simple form, $\pi_{iS} = hD_{iP}$, to establish the relationship between the two markets. To further explore the dependence of the strategies in the

[10] The predicted ΔMS is 0.28 and 0.15 at $j = 13$ and $j = 14$ respectively as $IP_{13} = 0.663$ and $IP_{14} = 0.709$ in the data. The actual values of ΔMS in the data also decrease at the border of $j = 13$ ($\Delta MS = 0.327$) and $j = 14$ ($\Delta MS = -0.095$).

two markets, we can also explicitly model the competition in the secondary product market with heterogeneous buyers by adopting a model of horizontal differentiation à la Hotelling (1929). The main results of our basic model still hold in such an extended model. The size of the loyalty window, $l(\theta)$, for firm L to obtain a profit advantage can be as large as 2/7 in this case.[11]

One additional aspect of our basic model that may be worth exploring is the asymmetry in cross-market network effects generated by loyal and non-loyal customers. Such asymmetry is possible because the cross-market network effect may not only depend on the size of the user base in the primary market, but also on the type of users. For example, in the newspaper market, the incremental value of an additional reader to an advertiser may depend on whether the reader has a high or low willingness to pay, because it is more likely for the former to purchase the advertised product than the latter. Hence, a reader with a high willingness to pay may generate a stronger cross-market network effect than a reader with a low willingness to pay. If we believe that loyal customers generally have a higher willingness to pay than non-loyal customers, then the network effect generated by the former may be higher than the latter. We can incorporate this possibility into our basic model by letting h' and h denote the cross-market network effect generated by the loyals and non-loyals, respectively, with $h' > h$. Remark 1 follows.

Remark 1 (Asymmetric Cross-Market Network Effect). The loyalty window stated in Proposition 1 can still hold in the presence of asymmetric cross-market network effect.

Remark 1 shows that the main result in our basic model is robust under an asymmetric cross-market network effect. However, from the derivations given in the appendix, the window of θ for firm L to outperform firm H becomes smaller as the difference between h' and h increases. This is quite intuitive because it becomes more difficult for a firm with smaller loyal customer base to be more profitable if loyal customers in the primary market are much more attractive than non-loyals to customers in the secondary market.

4.2. Implications for Market Entry and First-Mover Advantage/Disadvantage

We explore the possible strategic implications of our main findings for market entry and entry deterrence decisions by extending our basic model to a two-period game. We consider an incumbent and a potential entrant. In Period 1, the incumbent can establish a loyal segment, $0 \le \theta \le \theta_0 \le 1$, where θ_0 is the incumbent's maximum feasible loyalty-building level. We assume that the incumbent's cost of loyalty-building up to θ_0 is zero, but its cost to build a loyal segment larger than θ_0 is infinite. In Period 1, the incumbent decides its optimal level of loyalty-building to be effective in Period 2 with the anticipation of a potential entrant in Period 2. In Period 2, the entrant decides whether or not to enter the market at a fixed cost, F. The entrant enters if and only if its expected profit is higher than the fixed cost of market entry. If the entrant enters, firms decide their prices simultaneously. Otherwise, the incumbent decides its optimal price as a monopoly. We also assume that the incumbent in Period 1 cannot commit to its Period 2 price.[12] We denote the incumbent and the entrant to be firm H and L, respectively. Other assumptions are the same as in the basic model.

Solving firms' maximization problem leads to a total of four cases, as summarized in Lemma 2.

Lemma 2 (Optimal Strategies in the Entry Game). *The firms' optimal strategies depend on the incumbent's feasible loyalty-building level, θ_0, and the entrant's fixed entry cost, F, as shown in Table* 5.

Lemma 2 shows that the optimal strategy of the incumbent after entry occurs is to charge a high price when θ_0 is large. This is consistent with Davis et al. (2004) and Hauser and Shugan (1983), who suggest that responding with a price increase by the incumbent can be an optimal defensive strategy when a new product enters the market.

Lemma 2 also shows that an incumbent can earn a higher profit by strategically limiting its loyalty base even if loyalty-building is costless. Specifically, this "limited-loyalty" strategy is optimal when the incumbent's feasible loyalty-building level is in a mid-range and the entrant's entry cost is high (i.e., Case 2).

To understand this result, recall that the profit of the entrant maximizes at the midlevel of θ (see Figure 1). The entrant will enter the market only if its profit will be higher than the fixed cost of entry. If θ_0 is at the midlevel, it is possible for the incumbent to discourage the entrant from entering the market by building a smaller loyal base, $\theta^* < \theta_0$, because the entrant's profit can be lower when $\theta^* < \theta_0$ than $\theta^* = \theta_0$. Therefore, it can be optimal for the incumbent to under-invest in customer loyalty so that it can keep a "lean and hungry look" (Fudenberg and Tirole 1984) in order to deter entry.

Although we think this strategy of limiting loyalty base to deter entry is interesting, it should be applied

[11] The details can be found in a technical appendix available on the Website of this journal and in a working paper by the authors upon request.

[12] Our results in Lemma 2 and Proposition 3 will not be qualitatively different if we allow the incumbent to commit to its second period price in the first period.

Table 5 Results for Lemma 2

Market condition		Incumbent's decision				
Feasible loyalty	Entry cost	Optimal price	Optimal loyalty	Entrant's decision entering (Y/N)	Profit advantage	Case
High ($\theta_0 \geq \theta''$)		High $p^*_{HP2} = k$	Maximum ($\theta^* = \theta_0$)	$\begin{cases} \text{Yes} & \text{if } F < F' \\ \text{No} & \text{if } F \geq F' \end{cases}$	Incumbent	1
Mid-range ($\theta' < \theta_0 < \theta''$)	High $F > F^0$	Low $p^*_{HP2} = 0$	Non-maximum $\theta^* = \dfrac{(h-c)}{2k+h-c} < \theta_0$	No	Incumbent	2
	Low $F \leq F^0$	High $p^*_{HP2} = k$	Maximum ($\theta^* = \theta_0$)	Yes	Can be Entrant	3
Small ($\theta_0 \leq \theta'$)		Low ($p^*_{HP2} = 0$)	Maximum ($\theta^* = \theta_0$)	$\begin{cases} \text{Yes} & \text{if } F < F'' \\ \text{No} & \text{if } F \geq F'' \end{cases}$	Incumbent	4

Where: $\theta' = \dfrac{0.5(h-c)}{k+0.5(h-c)}$, $\theta'' = \dfrac{h-c}{k+h-c}$, $F^0 = \dfrac{k(h-c)}{2k+h-c}$, $F' = (h-c)(1-\theta_0)$, $F'' = 0.5(h-c)(1-\theta_0)$

with caution for two reasons. First, literature on entry deterrence (see Gruca and Sudharshan 1995 for a detailed review) has suggested many strategic actions for an incumbent firm to take for entry deterrence. Because strong loyalty always benefits the incumbent firm after the entrant's decision is made (no matter whether entry occurs or not), limiting its loyalty base should not be used as a primary strategy to deter entry when other strategic actions for entry deterrence are available. Second, firms with a technology advantage sometimes prefer to keep their technologies proprietary, which results in a limited loyalty base. Such strategy, however, often invites competitive entry, for example, Apple Computer's "firewire" technology invites competition from USB2. However, the technologically advantageous firms, such as Apple Computer, may still enjoy a high profit because they can charge high prices.[13]

Proposition 3 below is a direct extension of Proposition 1 in a two-period setting when the loyalty level is allowed to be determined endogenously.

Proposition 3 (Second Mover Advantage). *In markets with a cross-market network effect, an entrant firm with a disadvantage in customer loyalty can earn a higher profit than the incumbent firm with an advantage in customer loyalty. Specifically, the entrant can outperform the incumbent if* (a) *the incumbent's feasible loyalty level is at a midlevel, and* (b) *the entrant has a low entry cost* (*i.e., Case* 3 *in Lemma* 2).

When the entry is inevitable (i.e., a low cost of entry), with a mid-range of loyalty, the incumbent earns a higher profit by focusing on its loyal customers than by competing with the entrant for switchers. As explained in our basic model, this offers the entrant an opportunity to enjoy a higher profit than the incumbent. Previous marketing literature on pioneer advantage suggests various sources of pioneer advantage or disadvantage (Robinson and Fornell 1985, Robinson 1988, Golder and Tellis 1993, Kalyanaram et al. 1995). Complementing this stream of literature, our results in Proposition 3 and Lemma 2 indicate that customer loyalty established by a pioneer in a market with a cross-market network effect can be another important source of advantage or disadvantage for the pioneer. In particular, a pioneer with a midlevel number of loyal followers is likely to be leapfrogged by a second comer in a market with a cross-market network effect.

4.3. Conclusion

In this paper, we investigate the competitive implications of asymmetric loyalty in the market when presented with a cross-market network effect. We show that:

- Different from the traditional markets where an advantage in customer loyalty leads to an advantage in profit, in markets with a cross-market network effect, a firm with an advantage in customer loyalty can be leapfrogged by its rival in both profit and market share if its advantage in loyalty is neither sufficiently small nor sufficiently large.
- A cross-market network effect generates strategic dependence between the two markets such that the more competitive the secondary product market the more likely it will be for the firms to adopt differentiated pricing strategy in the primary product market, and the more likely that the firm with a loyalty disadvantage will be the market share leader in the primary product market.

[13] We thank the editor for pointing out this issue and providing the example.

- If the fixed cost of entry is low and the incumbent can only build a mid-sized loyalty segment, a second-mover advantage may endogenously occur because the entry cannot be deterred and the entrant may leapfrog the incumbent in profit.

Our findings indicate that a loyalty advantage may not lead to a profit advantage for an incumbent firm in markets with a cross-market network effect, but this by no means discounts the importance of building customer loyalty. As we have shown in this paper (also see Figure 1), a firm's profit in competition increases with the level of its customer loyalty, and the firm with very high customer loyalty can always outperform its competitor in both profit and market share. Therefore, it is still crucial for an incumbent firm in an industry characterized by a cross-market network effect to establish a sufficiently high level of customer loyalty.

Our study contributes to the literature on network effects by focusing on an understudied type of network effect: the cross-market network effect. It also complements the literature on first-mover advantage/disadvantage by showing a new source of first-mover advantage/disadvantage for industries presented with a cross-market network effect. In a broad sense, as suggested by Cabral and Villas-Boas (2005), the inter-temporal dependency of a firm's demand/profit can also be regarded as a type of cross-market network effect. For example, due to the existence of switching costs, a firm's demand/profit in the future may depend on its demand in the present (Klemperer 1995). Analogous to the cross-market network effect discussed in this paper, we may treat the future period as the market of the secondary product market and the present as the primary product market. In that case, our findings may also be applied in the context of an inter-temporal market dependency. However, future research is desirable to further investigate the interaction of customer loyalty management and inter-temporal market dependency in a dynamic setting.

Some limitations to our study suggest directions for future research. First, data collected from the newspaper industry were used to examine the pricing and market share implications generated from our theoretical model. Even though our empirical results were largely consistent with those implications, there were many shortcomings in our data. For example, we lack a good measure of consumer loyalty and firms' profits. It would be worthwhile in future empirical research to test the findings of this paper using more detailed data as well as data from different industries. Second, our theoretical model did not consider the potential means for a firm with a loyalty advantage to price discriminate among loyal versus non-loyal consumers, e.g., by using targeted promotions or introducing a "fight brand" to the low-end customers. Future research should also incorporate those strategies into the analysis. We expect price discrimination to benefit a firm with a large loyal customer base as long as the value of its demand in the product of primary market to the customers in the product of secondary market does not deteriorate severely due to such a practice. Finally, we assume that each customer purchases at most one unit of the primary product. Future research may explore potential usage differences between loyal versus non-loyal customers to further enrich our findings.

Acknowledgments
The authors thank Qi Wang for her help in data collection, Peter Golder for his comments on an early version of this paper, the participants at the Marketing Science Conference 2001 and the seminar participants at the Wharton School of the University of Pennsylvania and University of British Columbia for their helpful comments, and the editor, area editor, and three anonymous reviewers for their constructive suggestions.

Appendix. Table of Notations

Theoretical Model:

Notations in Basic Model

- i: Firms (high- or low-loyalty firm), $i = H, L$.
- j: Type of products (primary or secondary product), $j = P, S$.
- θ: The size of loyal segment of firm H.
- k, s: The reservation price of the loyal and non-loyal customers, respectively.
- p_{ij}: firm i's price for type j product.
- D_{ij}: firm i's demand for type j product.
- π_{ij}, π_i: firm i's profit from type j product, and firm i's total profit, respectively.
- h: Parameter that measures the strength of the cross-market network effect.
- p_0: The lower bound of price in the product of primary market.
- c: Marginal cost.

Additional Notations Used in §4

- D_{iP}^S: firm i's demand from non-loyals in the primary product market.
- m: The number of buyers in the secondary product market.
- d_i: The customer's distance to firm i on the unit line.
- t: The disutility per unit distance.
- θ_0: The incumbent's maximum feasible loyalty-building level.
- F: The fixed cost of entry.
- p_{HP2}^*: The incumbent's optimal period 2 price in the two-period model.

Empirical Analysis

- j: Firms, $j = 1, 2, \ldots, 22 =$ the incumbents, $j = 23, 24, \ldots, 44 =$ the entrants.
- T: Time, $T = -1, 0, 1$ denote the year before, when, and after the entry.
- $SR(T)_j$: firm j's subscription rate at time T.
- $AR(T)_j$: firm j's advertising rate at time T.

$C(T)_j$: firm j's circulation at time T.
$MS(T)_j$: firm j's market share of circulation at time T.
IP_j: The penetration level of incumbent j at the time of entry.
J: The cutoff level between a high ($j > J$) and low ($j \leq J$) penetration level for the incumbent at the time of entry.
D_j: Dummy variable, $D_j = 1$ if $j > J$ and $D_j = 0$, otherwise.

A.1. Justification of the Profit Specification $\pi_{iS} = hD_{iP}$

We provide a justification of the profit specification $\pi_{iS} = hD_{iP}$ made in §2 in the context of the circulation industry. In the circulation industry, firms sell newspapers or magazines to readers as the primary products and sell advertising space as the secondary product. We assume a representative advertiser with a fixed budget h that must be spent between the two firms in the market (it is equivalent to assume that there are n homogeneous advertisers, each with a budget of h/n to spend). Let D_{iS} be the amount of advertising on firm i, p_{iS} be firm i's unit rate for advertising, and $e(D_{iS})$ be the average gain of advertising from reaching a reader of firm i. We assume that the advertising response function $e(D_{iS})$ follows the typical S-shape, which is approximated by $e(D_{iS}) = \gamma \ln D_{iS}$ if $D_{iS} > D_0 > 1$ and $e(D_{iS}) = 0$ if otherwise. Then the total gain of the advertiser from advertising through firm i is $D_{iP}\gamma \ln D_{iS}$ if $D_{iS} > D_0$ and is 0 if otherwise, where D_{iP} is the total number of readers of firm i.

For a profit maximizing firm, p_{iS} will be such so that $D_{iS} > D_0$. Otherwise, the firm obtains no revenue from the advertiser. The advertiser maximizes the total gain of advertising subject to the budget constraint, which leads to

$$\max_{D_{HS},\, D_{LS}} \quad (\gamma D_{HP} \ln D_{HS} + \gamma D_{LP} \ln D_{LS})$$
$$\text{s.t.} \quad p_{HS} D_{HS} + p_{LS} D_{LS} \leq h$$

Solving the above optimization problem results in $\pi_{iS} = p_{iS} D_{iS} = hD_{iP}$, which gives the profit specification assumed in §2. We can see that the strength of the cross-market network effect, h, in this context can be interpreted as the budget (expenditure) per reader by the advertiser (as the size of reader's market is normalized to 1).

A.2. Proofs of Lemmas and Propositions

Proof of Lemma 1. From firm H's profit function given in (3), firm H will optimally set $p_{HP} = k$ if and only if $(k-c)\theta + h\theta > 0.5(1+\theta)(h-c)$, i.e., if $\theta > \underline{\theta} = (h-c)/(2k + h - c)$. Otherwise, firm H will set $p_{HP} = 0$. Given this condition, the corresponding prices, market shares and profits for both firms under $\theta > \underline{\theta}$ and $\theta \leq \underline{\theta}$ can be directly obtained from equations (2) and (3). The results are reported in the Table 1 in Lemma 1. □

Proof of Proposition 1. From Lemma 1, if $\theta \leq \underline{\theta}$, $\Delta\pi = \pi_H - \pi_L = (h-c) > 0$ always holds as h is assumed to be larger than c. If $\theta > \underline{\theta}$, then $\Delta\pi = \pi_H - \pi_L = [k + 2(h-c)]\theta - (h-c) < 0$ leads to $\theta < \bar{\theta} = (h-c)/[k + 2(h-c)]$. Therefore, the condition for $\Delta\pi < 0$ is $\underline{\theta} < \theta < \bar{\theta}$. To ensure $\underline{\theta} < \bar{\theta}$, we must have $h < \bar{h} = k + c$. In addition, $\underline{\theta} > 0$ implies $h > c$. Hence, the necessary and sufficient condition for $\Delta\pi < 0$ is $c = \underline{h} < h < \bar{h}$ and $\underline{\theta} < \theta < \bar{\theta}$. □

Proof of Proposition 2. From Lemma 1, if $\theta \leq \underline{\theta}$, $\Delta MS_P = D_{HP} - D_{LP} = \theta \geq 0$ always holds. If $\theta > \underline{\theta}$, then $\Delta MS_P = 2\theta - 1$ leads to $\theta < \bar{\bar{\theta}} = 1/2$. Therefore, the condition for $\Delta MS_P < 0$ is $\underline{\theta} < \theta < \bar{\bar{\theta}}$. To ensure $\underline{\theta} < \bar{\bar{\theta}}$ we must have $h < \bar{\bar{h}} = 2k + c$. In addition, $\underline{\theta} > 0$ implies $h > c$. Hence, the necessary and sufficient condition for $\Delta MS_P < 0$ is $c = \underline{h} < h < \bar{\bar{h}}$ and $\underline{\theta} < \theta < \bar{\bar{\theta}}$. □

Proof of Remark 1. Let D_{iP}^S, $i = 1, 2$ denote firm i's demand in the primary market among the non-loyals. $D_{iP}^S = 1 - \theta$ if $p_{iP} > p_{3-iP}$. Otherwise, $D_{iP}^S = 0$. Firms' profit can be written as

$$\begin{cases} \pi_H = (p_{HP} - c)(\theta + D_{HP}^S) + h'\theta + hD_{HP}^S \\ \pi_L = (p_{LP} - c)D_{LP}^S + hD_{LP}^S. \end{cases}$$

Similar to the results in our basic model, firm L will adopt a secondary-product-driven strategy at a low price, $p_{LP} = 0$. But firm H has two options: (1) adopting a "primary-product-driven" strategy at a high price, or (2) adopting a "secondary-product-driven" strategy at a low price, depending which strategy leads to higher profit. If $\theta(h' - c) + 0.5(1-\theta)(h-c) < \theta(k + h' - c)$, then we have $p_{HP} = k$, $p_{LP} = 0$, $\pi_H = \theta(k + h' - c)$, and $\pi_L = (1-\theta)(h-c)$. If $\theta(h'-c) + 0.5(1-\theta)(h-c) \geq \theta(k + h' - c)$, then $p_{HP} = 0$, $p_{LP} = 0$, $\pi_H = \theta(h'-c) + 0.5(1-\theta)(h-c)$, and $\pi_L = 0.5(1-\theta)(h-c)$. $\pi_H < \pi_L$ occurs if and only if $\theta(h'-c) + 0.5(1-\theta)(h-c) < \theta(k + h' - c)$ and $(1-\theta)(h-c) > \theta(k + h' - c)$, i.e., $\underline{\theta} = (h-c)/(2k + h - c) < \theta < (h-c)/(k + h' + h - 2c) = \bar{\theta}'$. To ensure $\underline{\theta} < \bar{\theta}'$ and $\bar{\theta}' > 0$, we must have $c = \underline{h} < h < h' < \bar{h}' = k + c$. Hence, the necessary and sufficient condition for $\pi_H < \pi_L$ is $\underline{h} < h < h' < \bar{h}'$ and $\underline{\theta} < \theta < \bar{\theta}'$. We can see $\bar{\theta}' - \underline{\theta}$ decreases with $h' - h$ because $\bar{\theta}' = (h-c)/(k + h' + h - 2c) = (h-c)/[k + h' - h + 2(h-c)]$ decreases as $h' - h$ increases. □

Proof of Lemma 2. The incumbent's optimal price in Period 2 is:

Monopoly Market:

$$p_{HP2}^* = \begin{cases} k & \text{if } \theta(h + k - c) > (h - c) \\ 0 & \text{otherwise} \end{cases} \tag{A1}$$

Duopoly Market:

$$p_{HP2}^* = \begin{cases} k & \text{if } \theta(h + k - c) > 0.5(h-c)(1+\theta) \\ 0 & \text{otherwise.} \end{cases} \tag{A2}$$

The entrant's entry decision depends on the cost of entry, F, and profit, π_L. The latter, as shown in (A3), depends on the incumbent's price:

$$\pi_L = \begin{cases} 0.5(h-c)(1-\theta) \\ \quad \text{if The incumbent prices low } (p_{HP2} = 0) \\ (h-c)(1-\theta) \\ \quad \text{if The incumbent prices high } (p_{HP2} = k). \end{cases} \tag{A3}$$

The entrant will enter if $\pi_L > F$ as shown in (A4):

$$\text{The entrant: } \begin{cases} \text{Enter if } 0.5(h-c)(1-\theta) > F \\ \quad \text{Not Enter, otherwise} \quad \text{when } p_{HP2} = 0 \\ \text{Enter if } (h-c)(1-\theta) > F \\ \quad \text{Not Enter, otherwise} \quad \text{when } p_{HP2} = k. \end{cases} \tag{A4}$$

Finally, the incumbent chooses the optimal loyalty level, θ^*, that maximizes its profit:

$$\operatorname*{Max}_{\theta} \quad \pi_H$$

$$\text{s.t.} \begin{cases} \pi_H = \max[\theta(h+k-c), (h-c)] \quad \text{if } \pi_L \le F \\ \pi_H = \max[\theta(h+k-c), 0.5(h-c)(1+\theta)] \\ \quad \text{if } \pi_L > F \\ \pi_L = 0.5(h-c)(1-\theta) \\ \quad \text{if } \theta(h+k-c) \le 0.5(h-c)(1+\theta) \\ \pi_L = (h-c)(1-\theta) \\ \quad \text{if } \theta(h+k-c) > 0.5(h-c)(1+\theta) \\ \theta \le \theta_0 \end{cases} \tag{A5}$$

The optimization problem specified in Equation (A5) leads to four exhaustive and mutually exclusive cases below.

Case 1. $\theta_0(k+h-c) \ge h-c$

This case corresponds to the High Feasible Loyalty case in Lemma 2. In this case, the incumbent can obtain a higher profit by setting $p_{HP} = k$ and $\theta = \theta_0$ regardless of firm L's entering decision. Therefore, we have $\theta^* = \theta_0$, $p_{HP} = k$, $\pi_H = \theta_0(k+h-c)$, and $\pi_L = (h-c)(1-\theta_0) < \pi_H$. Firm L enters only if $F < F' = \pi_L$.

Case 2 and 3. $0.5(h-c)(1+\theta_0) < \theta_0(k+h-c) < h-c$

These two cases correspond to the Mid-range Feasible Loyalty case in Lemma 2. In these cases, if firm H is a monopoly, it can obtain a higher profit by setting $p_{HP} = 0$ to get all the consumers than by setting $p_{HP} = k$ and $\theta^* = \theta_0$. However, firm H can attract all the consumers only if firm L does not enter. Therefore, firm H will discourage firm L from entering if it can successfully do so. For this purpose, firm H should choose θ to minimize firm L's profit after entering. From firm L's profit function given in equation (A3), π_L is minimized at θ^* that solves $0.5(h-c)(1+\theta^*) = \theta^*(k+h-c)$, i.e., $\theta^* = (h-c)/(2k+h-c)$. At this θ^*, $\pi_L(\theta^*) = 0.5(h-c)(1-\theta^*) = k(h-c)/(2k+h-c)$. Note that we have $\theta^* < \theta_0$ because $0.5(h-c)(1+\theta_0) < \theta_0(k+h-c)$.

If $F > F^0 = k(h-c)/(2k+h-c)$, firm L does not enter so that firm H's deterrence strategy works. We have $p_{HP} = 0$ and $\pi_H = h-c$. This corresponds to Case 2 in Lemma 2.

However, if $F \le F^0 = k(h-c)/(2k+h-c)$, firm L will enter anyway so that firm H's deterrence strategy cannot work. In this situation, it is optimal for firm H to set $\theta^* = \theta_0$ and $p_{HP} = k$ because $0.5(h-c)(1+\theta_0) < \theta_0(k+h-c)$. This results in $\pi_H = \theta_0(k+h-c)$ and $\pi_L = (h-c)(1-\theta_0)$. This corresponds to Case 3 in Lemma 2. We can see that $\pi_L > \pi_H$ in this case if $0.5(h-c)(1+\theta_0) < \theta_0(k+h-c) < (h-c)(1-\theta_0) < h-c$, which results in the same conditions as those given in Proposition 1.

Case 4. $\theta_0(k+h-c) \le 0.5(h-c)(1+\theta_0)$

This case corresponds to the Small Feasible Loyalty case in Lemma 2. In this case, it is always optimal for firm H to set $\theta^* = \theta_0$ and $p_{HP} = 0$ regardless of firm L's entering decision. Therefore, we have $\theta^* = \theta_0$, $p_{HP} = 0$, $\pi_L = 0.5 \cdot (h-c)(1-\theta_0)$, $\pi_H = 0.5(h-c)(1+\theta_0) > \pi_L$ if $F < F'' = \pi_L$ and $\pi_H = h$ if $F \ge \pi_L$. Firm L enters if $\pi_L - F > 0$. □

Proof of Proposition 3. This results directly from the derivations of Case 3 in Lemma 2.

References

Basu, Amiya, Tridib Mazumdar, S. P. Raj. 2003. Indirect network externality effects on product attributes. *Marketing Sci.* **22**(2) 209–221.

Business Week. 2005. Big media, little blogosphere. (October 24).

Cabral, Luis M. B., J. Miguel Villas-Boas. 2005. Bertrand supertraps. *Management Sci.* **51** 599–613.

Carpenter, Gregory S., Kent Nakamoto. 1989. Consumer preference formation and pioneering advantage. *J. Marketing Res.* **26** 285–298.

Carvajal, Doreen. 2004. Fast-reading free papers win readers and imitators. *New York Times* (October 18) C10.

Chakravarti, Amitav, Jinhong Xie. 2006. The impact of standards competition on consumers: Effectiveness of product information and advertising formats. *J. Marketing Res.* **43**(2) 224–236.

Chaudhri, Vivek. 1998. Pricing and efficiency of a circulation industry: The case of newspapers. *Inform. Econom. Policy* **10** 59–76.

Chen, Yuxin, Chakravarthi Narasimhan, Z. John Zhang. 2001. Individual marketing with imperfect targetability. *Marketing Sci.* **20**(1) 23–41.

Church, Jeffrey R., Neil Gandal. 1992. Network effects, software provision and standardization. *J. Indust. Econom.* **XL** 85–104.

Church, Jeffrey R., Neil Gandal. 1993. Complementary network externalities and technological adoption. *Internat. J. Indust. Organ.* **11** 239–260.

Crain's New York Business. 2005. Free AM, metro papers pressing paid dailies. (April 18).

Davis, Steven J., Kevin M. Murphy, Robert H. Topel. 2004. Entry, pricing, and product design in an initially monopolized market. *J. Political Econom.* **112**(1) S188–S225.

Editor & Publisher. 2002. Jersey dailies discount ABC rule. (March 11).

Farrell, Joseph, Garth Saloner. 1986. Installed base and compatibility: Innovation, product preannouncements, and predation. *Amer. Econom. Rev.* **76**(5) 940–955.

Fudenberg, Drew, Jean Tirole. 1984. The fat-cat effect, the puppy-dog ploy and the lean and hungry look. *Amer. Econom. Rev.* **74**(2) 361–366.

Guardian, The. 2005a. Murdoch worried as metro eats into sales of the sun. (February 3).

Guardian, The. 2005b. New York Times gambles on fees for online content: "National" brand sees Web advertising tailing off as market matures. (May 18).

Glazer, A. 1985. The advantage of being first. *Amer. Econom. Rev.* **75**(3) 473–480.

Godes, David, Elie Ofek, Miklos Sarvary. 2003. Products vs. advertising: Media competition and the relative source of firm profits. Working paper.

Golder, Peter N., Gerard J. Tellis. 1993. Pioneer advantage: Marketing logic or marketing legend? *J. Marketing Res.* (May) 158–170.

Gruca, Thomas S., D. Sudharshan. 1995. A framework for entry deterrence strategy: The competitive environment, choices, and consequences. *J. Marketing* (July) 44–55.

Gupta, S., D. Jain, M. Sawhney. 1999. Modeling the evolution of markets with indirect network effect: An application to digital television. *Management Sci.* **18**(3) 396–416.

Harikesh, Nair, Pradeep Chintagunta, Jean-Pierre Dube. 2004. Empirical analysis of indirect network effects in the market for personal digital assistants. *Quant. Marketing Econom.* **2** 23–58.

Hauser, John, Steve Shugan. 1983. Defensive marketing strategies. *Marketing Sci.* **2**(4) 319–359.

Hotelling, H. 1929. Stability in competition. *Econom. J.* **39**(153) 41–57.

Kalyanaram, Gurumurthy, William Robinson, Glen L. Urban. 1995. Order of market entry: Established empirical generalizations, emerging empirical generalizations, and future research. *Marketing Sci.* **14**(3) G212–G221.

Katz, Michael, Carl Shapiro. 1985. Network externalities, competition, and compatibility. *Amer. Econom. Rev.* **75**(June) 424–440.

Klemperer, Paul. 1995. Competition when consumers have switching costs: An overview with applications to industrial organization, macroeconomics, and international trade. *Rev. Econom. Stud.* **62** 515–539.

Lieberman, Marvin B., David B. Montgomery. 1988. First-mover advantage. *Strategic Management J.* **9** 41–58.

Lilien, Gary L., Eunsang Yoon. 1990. The timing of competitive market entry: An exploratory study of new industrial products. *Management Sci.* **36** 568–585.

Mittal, Vikas, Eugene W. Anderson, Akin Sayrak, Pandu Tadikamalla. 2005. Dual emphasis and the long-term financial impact of customer satisfaction. *Marketing Sci.* **24**(4) 544–555.

Narasimhan, Chakravarthi. 1988. Competitive promotional strategies. *J. Bus.* **61**(4) 427–449.

Narasimhan, Chakravarthi, Z. John Zhang. 2000. Market entry strategy under firm heterogeneity and asymmetric payoffs. *Marketing Sci.* **19**(4) 313–327.

Ofek, Elie, Miklos Sarvary. 2001. Leveraging the customer base: Creating competitive advantage through knowledge management. *Management Sci.* **47** 1441–1456.

Padmanabhan, V. Surendera Rajiv, Kannan Srinivasan. 1997. New products, upgrades, and new releases: A rationale for sequential product introduction. *J. Marketing Res.* **34** 456–476.

Parker, Geoffrey, Marshall W. Van Alstyne. 2005. Two-sided network effects: A theory of information product design. *Management Sci.* **51**(10) 1495–1504.

Pauwels, Koen, Shuba Srinivasan. 2004. Who benefits from store brand entry? *Marketing Sci.* **23**(3) 364–390.

Pradeep, K. Chintagunta, Ramarao Desiraju. 2005. Strategic pricing and detailing behavior in international markets. *Marketing Sci.* **24**(1) 67–80.

Robinson, William T. 1988. Sources of market pioneer advantage: The case of industrial goods industries. *J. Marketing Res.* **25** 87–94.

Robinson, William T., Claes Fornell. 1985. Sources of market pioneer advantage in consumer goods industries. *J. Marketing Res.* **22** 305–317.

Rochet, Jean-Charles, Jean Tirole. 2003. Platform competition in two-sided markets. *J. Eur. Econom. Assoc.* **1** 990–1029.

Shankar, V., B. Bayus. 2003. Network effects and competition: An analysis of the home video game industry. *Strategic Management J.* **24** 375–384.

Soberman, David, Hubert Gatignon. 2005. Research issues at the boundary of competitive dynamics and market evolution. *Marketing Sci.* **24**(1) 165–174.

Srinivasan, Raji, Gary L. Lilien, Arvind Rangaswamy. 2004. First in, first out? The effects of network externalities on pioneer survival. *J. Marketing* **68** 41–58.

Strauss, Steven. 2000. Marketing strategies for products with cross-market network externalities. Working paper, Yale School of Management, New Haven, CT.

Sun, Baohong, Jinhong Xie, Henry Cao. 2004. Product strategy for innovators in markets with network effects. *Marketing Sci.* **23**(Spring) 243–254.

Wall Street Journal, The. 2001. Audit bureau moves to change magazine rules. (March 12).

Wang, Qi, Jinhong Xie. 2006. Intra-standard competition: Impact of supporting-firm-base and stage-dependent competitive interaction. Working paper, University of Florida, Gainesville, FL.

Wernerfelt, Birger. 1991. Brand loyalty and market equilibrium. *Marketing Sci.* **10**(3) 229–245.

Xie, Jinhong, Marvin Sirbu. 1995. Price competition and compatibility in the presence of positive demand effect. *Management Sci.* **41** 909–926.