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# Online expansion: is it another kind of strategic manufacturer response to a dominant retailer?

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**Abstract:** The issues of channel conflict and channel power have received widespread research attention, including Geylani et al.'s (2007) work on channel relations in an asymmetric retail setting. Specifically, these authors suggest that a manufacturer can respond to a dominant retailer's pricing pressure by raising the wholesale price for a weak retailer over that for the dominant retailer while transferring demand to the weak retailer channel via cooperative advertising. But, is online expansion another kind of strategic manufacturer's optimal response to a dominant retailer? In this paper, we extend this work by adding a direct online selling channel to illustrate the impact of the manufacturer's internet entry on firms' demands, profits, and pricing strategies and on consumer welfare. Our analysis thus includes a condition in which the manufacturer can add an online channel. If such an online channel is opened, the channel-supported network externality will always benefit the manufacturer but hurt the retailers. Consumers, however, will only benefit from the network externality when a dominant retailer is present and will be hurt when both retailers are symmetric.

## 1 Introduction

Recently, there has been a considerable expansion of work devoted to examining the power of dominant retailers. One possible guide for investigating channel strategy in the presence of a dominant retailer is the theoretical model proposed by Geylani et al. (2007), which demonstrates that a strategic manufacturer can respond to a dominant retailer's pricing pressures by raising the wholesale price for a weak retailer while transferring demand to this weak retailer through joint promotions and advertising. In practice, we note that Procter & Gamble, perhaps the best example, sells its products either through dominant retailers like Wal-Mart or weak retailers like franchised retail stores. While doing so, the company is blazing a trail in direct online selling to improve interactions with consumers. In fact, in January 2012, a Procter & Gamble spokesperson told the Wall Street Journal that the consumer-packaged goods giant was looking at its new e-Store (<http://www.pgestore.com>) pilot project as a 'learning lab' (Retail Wire, 2012). Likewise, Lung Nilfisk, one of the ten largest sellers of local cosmetics brands in China, is expanding to online markets while still selling products in traditional stores. This company, which formerly sold its

products either in huge supermarkets like Wal-Mart or Carrefour or in small franchised retail stores, has been exploring new ways to create direct relationships with consumers since receiving its direct selling license in 2008. For instance, it now allows consumers to conveniently log into a member management system to search for their favourite products. In the personal computer market, the third largest US PC manufacturer, Gateway, also distributes its products both through its direct internet channel and through huge independent retailers like Best Buy and Costco (Yoo and Lee, 2011). Therefore, we propose a new question: is online expansion another kind of strategic manufacturer's optimal response to a dominant retailer?

When the focus is on direct internet selling, however, the unique highly interactive features of online shopping environments should never be ignored. See in Viswanathan (2005), the web possesses unique features that traditional channels for commerce lack – customisation; interactivity; multimedia abilities; global access unconstrained by time and space limitations; ability to access, store and transmit information inexpensively; and the ability to conduct transactions in real time. These technological capabilities such as interactivity and real-time communications have direct consequences for businesses as well as consumers. For example, firms like Amazon.com have leveraged their customer base to add value through user ratings, reviews and feedback. These user communities generate significant direct as well as indirect network externalities. The offline channel offers much less scope for such community building, and consequently, a much lower possibility for the creation of network externalities. When firms are making strategic decisions, especially about online selling, they must never neglect channel-supported network externalities that may directly influence the equilibrium prices, market shares, and the profits of related firms (see Conner, 1995; Arthur, 1996; Haubl and Trifts, 2000; Bickart and Schindler, 2001; Basu et al., 2003; Asvanund et al., 2004; Viswanathan, 2005; Tomak and Keskin, 2008; Prasad et al., 2010; Tirunillai, 2011).

Yet the literature on a manufacturer's decision to introduce a direct online selling channel is scant, especially as it relates to online channel-supported network externalities and their impact on manufacturer and retailers' pricing decisions and profit levels in the supply chain context outlined by Geylani et al. (2007). Our purpose in this paper, therefore, is to extend these authors' work by examining the decision-making implications of a manufacturer's direct internet entry when its downstream retailers are asymmetric and a channel-supported network externality exists in the online channel, a condition that, to our knowledge, has not previously received formal consideration.

One aspect that has received widespread academic attention is dual channel management, which many studies have addressed in terms of the impact of a supplier or manufacturer's direct internet encroachment on the profits and equilibriums of channel members (see Chiang et al., 2003; Cattani et al., 2004, 2006; Arya et al., 2006; Kumar and Ruan, 2006; Liu and Zhang, 2006; Dumrongsiri et al., 2008; Yoo and Lee, 2011; Xiong et al., 2012). We therefore ask the following questions:

- Under what condition is it profitable for a supplier to engage in online selling, especially when the online channel has delayed positive network externalities?
- What is the impact of the network externality in the online channel on the pricing strategies and profits of all firms?
- How does channel power between a manufacturer and its retailer affect the competitive outcomes of the equilibriums?

- What is the effect on consumers when the manufacturer engages in online selling?

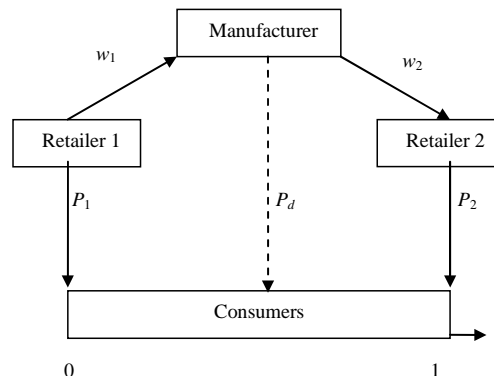
The remainder of this paper is organised as follows. Section 2 introduces the model together with its corresponding settings and assumptions. This section also provides the basic modelling framework and characterises the equilibriums that defines the manufacturer's direct internet entry. Section 3 analyses the impact of asymmetric retailing costs on the manufacturer's internet entry and the equilibriums. Section 4 shows the comparative analysis from the perspective of channel power and channel-supported network externality. Section 5 reveals the effect of manufacturer's direct entry on consumer welfare. Section 6 concludes the paper and suggests directions for future research. All proofs are presented in the Appendix.

## 2 The model

### 2.1 Settings and assumptions

The structure of the market under consideration consists of an upstream manufacturer supplying a (homogeneous) good to two competing retailers. As shown in Figure 1, in the model which is based on the same supply chain structure as used in Geylani et al. (2007), the manufacturer is unable to directly influence the wholesale price for the dominant retailer (Retailer 1) and the retailers are asymmetric. After the manufacturer's direct internet entry, consumers can choose to shop either online or offline.

**Figure 1** The model (manufacturer's direct entry when Retailer 1 behaves as a dominant retailer)



In line with previous studies, we assume that the two retailers are located at both ends of a Hotelling line bounded between zero and one, and that every consumer in the market makes either a one-unit purchase or none at all. All consumers are uniformly distributed along the line with a constant unit transportation cost of  $t$ , which, without loss of generality and as in most earlier research, we set to equal 1 (Pazgal and Soberman, 2007). We first assume that all retailers' marginal cost of retailing is asymmetric and to be zero, and then investigate the impact of retailer cost asymmetry in Section 3 (Geylani et al., 2007). Based on the same assumptions as made by Liu and Zhang (2006), the manufacturer's marginal cost for producing the product in question is zero. Each consumer's reservation price is  $V$  and  $V > 4t$  to insure that the consumers' utility is not

negative and the market is completely covered; that is,  $V > 4$ . If the manufacturer decides to open an online channel, the fixed cost for setting one up is  $F$ , and all consumers incur the same shopping cost  $s$  to purchase online, one that consists mainly of the cost to access the internet. We also assume that the shopping cost will never be too large and so let  $s < 2t$ ; that is,  $0 < s < 2$  (Liu and Zhang, 2006). The utility of the consumers purchasing online is thus the same and independent of their locations. The basic parameters are given in Table 1.

**Table 1** Model parameters

$R_1, R_2, M$	Retailer 1, Retailer 2, and manufacturer
$p_1, p_2, p_d$	The retail prices of the two retailers and the online price of the manufacturer
$w$	Wholesale prices set by the manufacturer
$x$	The location of marginal consumers for $R_i$ and the online channel, $i = 1, 2$
$s$	Consumers' online shopping cost
$F$	Fixed cost of setting up an online channel

Market behaviour is characterised as a two-stage complete information game. In the first stage, the manufacturer sets the wholesale price and then, based on these levels, in the second stage, the two retailers compete in retail prices when the manufacturer has not opened an online channel. When a channel has been opened, we assume that in the second stage, the manufacturer is the price leader and sets its online selling price before the retailers (Liu and Zhang, 2006).

## 2.2 Manufacturer's direct entry

### 2.2.1 Single-period problem

We first analyse a single-period problem where consumers do not enjoy any benefit from network externalities and then expand it to a two-period problem with respect to the network externality. In a single period, the manufacturer sells to both retailers while competing with them in the market. Hence, a consumer located at  $x$  should choose to purchase online or from one retailer to maximise his utility. As in Liu and Zhang (2006) and Liu (2006), consumers located close to retailers will buy from retail stores and those located far away from retailers will choose to shop online. Therefore, consumer utility as a function of location  $x$  is as follows:

$$U(i; x) = \begin{cases} V - x - p_1, & i = R_1 \\ V - (1 - x) - p_2, & i = R_2 \\ V - p_d - s, & i = M \end{cases}$$

The marginal consumer who is indifferent between  $R_1$  and online is located at  $x_1$  when  $V - x_1 - p_1 = V - p_d - s$ . The consumer who is indifferent between  $R_2$  and online is located at  $x_2$  when  $V - (1 - x_2) - p_2 = V - p_d - s$ . Consequently,  $R_i$ 's second stage profit is given by  $\pi(R_i) = (p_i - w_i)(p_d + s - p_i)$ ,  $i = 1, 2$  and both retailers' optimal pricing in the second

stage is  $p_i = \frac{1}{2}(p_d + s + w_i)$ ,  $i = 1, 2$ . What should be clear under this Hotelling linear

model is that when the manufacturer enters into direct internet marketing, the two retailers' face-to-face competition stops and they must both compete with the online

store. Hence, the manufacturer's direct entry steals away some of the neutral consumers from both retailers. This dynamic is similar to that in Balasubramanian's (1998) model, in which the direct channel presence is so strong that each retailer competes against the online marketer rather than against neighbouring retailers. The manufacturer's payoff is  $\pi(M) = w_1x_1 + w_2(1 - x_2) + p_d(x_2 - x_1) - F$ . Because the manufacturer will only add an online selling channel if it will lead to higher total profits, we derive the following condition for the manufacturer opening an online channel:

*Proposition 1:* When the dominant retailer dictates the wholesale price, the manufacturer may open an online channel only when  $F < \frac{2s^2 - 4s + 1}{8}$  and  $0 < s < \frac{2 - \sqrt{2}}{2}$ . Once the online channel is added, the equilibriums are given by

$$\begin{aligned} w_2^* &= w_1, p_1^* = w_1 + \frac{2-s}{4}, p_2^* = w_1 + \frac{2+s}{4}, \\ p_1^* &= w_1 + \frac{4+s}{4}, q_1 = \frac{2+s}{4}, q_2 = \frac{s}{4}, q_d = \frac{1-s}{4}, \\ \pi(M) &= w_1 + \frac{s^2 - 2s + 2}{4} - F, \pi(R_1) = \frac{(2+s)^2}{16}, \pi(R_2) = \frac{s^2}{16} \end{aligned}$$

Obviously, the market share and profit of both retailers are greatly cut down, especially the weak retailer when it is convenient to shop online – that is, when the online shopping cost is small enough. The online selling price is higher than the dominant retailer's selling price and lower than weak retailer's, which departures from the common sense that online selling price is generally lower.

### 2.2.2 Two-period problem under a network externality

As shown by Viswanathan (2005), one of the key channel parameters driven by the technological capabilities that differentiate online from traditional channels is the positive consumption externality, a factor that has major significance even when the same product or commodity is sold in both traditional and technology-driven channels. Adopting this same assumption with a primary focus on the unique features between online and offline selling, we assume that, without loss of generality, there are no externalities offline. In addition, because all the products sold in the system are the same, we, like Liu and Zhang (2006) and Balasubramanian (1998), rule out the trivial case of the existence of a switching cost. Table 2 summarises the new parameters.

**Table 2** Additional model parameters

$p_i^j$	Price set by firm $i$ in period $j$ , $i = 1, 2$ , $d$ ; $j = 1, 2$
$x_i^j$	Marginal consumers' location for $R_i$ and the online channel in period $j$ , $i = 1, 2$ ; $j = 1, 2$
$q_i^j$	Market share for firm $i$ in period $j$ , $i = 1, 2$ , $d$ ; $j = 1, 2$
$\delta$	The degree of the network externality
$w_i$	The wholesale price set by the manufacturer for retailers in period $j$ , $j = 1, 2$

Given an online channel-supported network externality, in the second period, consumers will derive utility from the network of first-period online consumers, meaning that the surplus for consumers who shop online in the second period can be

characterised by  $U = V - p_d^2 - s + \delta q_d^1$  and the value range of the network externality is  $[0, 1]$  (Viswanathan, 2005). Hence, when facing an externality, the manufacturer, in setting its price, must take into consideration not only the impact on its first-period demand and profitability but also the effect of its first-period demand on its second-period demand and profits. The manufacturer must therefore choose its first-period prices to maximise its total profits over both periods. We thus specify first-period demand by first using backward induction to solve the firms' optimal second-period prices. The surplus for a consumer at  $x$  who buys from  $R_1$  in the second period will be  $V - p_1^2 - x$ ; that for a consumer who buys from  $R_2$  in the second period will be  $V - p_2^2 - (1-x)$ . Therefore, in the second period, the indifferent consumer that purchases from  $R_1$  and  $M$  is located at  $x_1^2 = p_1^2 + s - \delta q_1^1 - p_1^2$  and the indifferent consumer that purchases from  $R_2$  and  $M$  is located at  $x_2^2 = 1 - p_2^2 - s + \delta q_2^1 + p_2^2$ .

We begin by computing the second-period demand for all firms. The second-period objective functions for the two retailers are as follows

$$\pi_i(R_i) = (p_i^2 - w_i^2)(p_i^2 + s - \delta q_i^1 - p_i^2), i = 1, 2$$

By solving the first-order conditions, we then obtain the following optimal retail prices:

$$p_i^2 = \frac{1}{2} (p_i^2 + s - \delta q_i^1 + w_i^2), i = 1, 2$$

So as the manufacturer should set its first period price while taking into consideration the effect of its first period demand on its profitability in second period, the profit function across two periods of the manufacturer is given by

$$\pi(M) = w_1^1 q_1^1 + w_1^2 q_1^2 + p_1^1 q_1^1 + w_1^2 q_1^2 + w_2^2 q_2^2 + p_2^2 q_2^2$$

*Proposition 2:* If  $s \geq 1$ , the manufacturer will never open an online channel, but if

$s \leq \frac{1}{2}\delta$ , the manufacturer will only sell through the dominant retailer and online. When

$\frac{1}{2}\delta < s < 1$ , the optimal prices and market shares for all firms in both periods are as

follows:

$$\begin{aligned} p_d^1 &= w_1^1 + \frac{4 - 3\delta - 2s(1-\delta)}{2(2-\delta)}, p_d^2 = w_1^2 + \frac{4 - \delta - 2s}{2(2-\delta)}, p_1^1 = w_1^1 + \frac{4 + 2s - 3\delta}{4(2-\delta)}, \\ p_2^1 &= w_1^1 + \frac{8 - 5\delta + 2s}{4(2-\delta)}, p_1^2 = w_1^2 + \frac{4 + 2s - 3\delta}{4(2-\delta)}, p_2^2 = w_1^2 + \frac{8 - 5\delta + 2s}{4(2-\delta)}, \\ q_1^1 = q_1^2 &= \frac{4 + 2s - 3\delta}{4(2-\delta)}, q_d^1 = q_d^2 = \frac{1-s}{2-\delta}, q_2^1 = q_2^2 = \frac{2s - \delta}{4(2-\delta)}, \\ \Pi(M) &= w_1^1 + w_1^2 + \frac{2(1-s)^2 + 2 - \delta}{2(2-\delta)}, \Pi(R_1) = \frac{(4 + 2s - 3\delta)^2}{8(2-\delta)^2}, \Pi(R_2) = \frac{(2s - \delta)^2}{8(2-\delta)^2} \end{aligned}$$

It is readily apparent that when online shopping is sufficiently convenient (i.e., the online shopping cost is sufficiently low) and a dominant retailer is present, the weak retailer will be driven out of market. Hence, as the online network externality increases, the

manufacturer's profit level rises but both retailers' profits drop. Therefore, the online channel network externality will always benefit the manufacturer but hurt the retailers.

### 3 Asymmetry in retailing costs

With the same signification in Geylani et al. (2007), the manufacturer should recognise that even if retailers such as Wal-Mart benefit from operational efficiencies, their raw ability to dictate supply prices can be an additional factor in achieving low costs. Therefore, we let  $c_1$  and  $c_2$  ( $c_2 > c_1 \geq 0$ ) to denote the marginal costs of retailing of both retailers.

#### 3.1 Single period problem

The retailers' pricing decision is to maximise

$$\pi(R_i) = (p_i - w_i - c_i)(p_d + s - p_i), i = 1, 2$$

*Proposition 3:* In a single period, when retailers' operational costs are asymmetric, the wholesale price for the weak retailer is lower than that when retailers' operational costs are symmetric while the direct online selling price is higher. The manufacturer will add an online channel only when

$$F < \frac{1}{24} (2(c_1^2 + c_2^2 + c_1c_2) + 6(1-s)(c_1 + c_2) + 6s^2 - 12s + 3)$$

If  $s < c_2$  and the manufacturer decides to open the online channel, the weak retailer will be driven out of market.

#### 3.2 Two-period problem under a network externality

With the same solution process in Section 3.2.2, we derive the following proposition.

*Proposition 4:* The two period equilibriums are shown as follows.

$$\begin{aligned} p_d^1 &= w_1^1 + \frac{2(4-3\delta-2s(1-\delta)) + (4-3\delta)c_1 - \delta c_2}{4(2-\delta)}, w_2^1 = 1 + w_1^1 - \frac{c_2 - c_1}{2}, \\ w_2^2 &= 1 + w_1^2 - \frac{c_2 - c_1}{2}, p_1^1 = w_1^1 + \frac{8-6\delta+4s+(12-7\delta)c_1 - \delta c_2}{8(2-\delta)}, \\ p_2^1 &= w_1^1 + \frac{16-10\delta+4s+(8-5\delta)c_1 + (4-3\delta)c_2}{8(2-\delta)}, \\ p_d^2 &= w_1^2 + \frac{(4-\delta)c_1 + \delta c_2 + 8-2\delta-4s}{4(2-\delta)}, p_1^2 = w_1^2 + \frac{8+4s-6\delta+(12-7\delta)c_1 - \delta c_2}{8(2-\delta)}, \\ p_2^2 &= w_1^2 + \frac{16-10\delta+4s+(8-5\delta)c_1 + (4-3\delta)c_2}{8(2-\delta)}, q_1^1 = q_1^2 = \frac{2(1-s) + c_1 + c_2}{2(2-\delta)}, \\ q_1^1 = q_1^2 &= \frac{8+4s-6\delta-(4-\delta)c_1 - \delta c_2}{8(2-\delta)}, q_2^1 = q_2^2 = \frac{4s-2\delta-\delta c_1 - (4-\delta)c_2}{8(2-\delta)}. \end{aligned}$$



The wholesale price for the weak retailer is higher when retailers' cost asymmetry decreases. This means that when the marginal cost of the dominant retailer is given, the weak retailer may pay more if its marginal operation cost gets lower and less if reverse. It is clear from the proposition that, the situation for the weak retailer is more severe as when  $\delta c_1 + (4 - \delta)c_2 > 4s - 2\delta > 0$ , the weak retailer will be driven out of market. Obviously, all firms' final equilibrium decisions are affected by the marginal operational costs of both retailers. The first period price of the manufacturer is increasing with  $c_1$  and decreasing with  $c_2$  while the second period price is increasing with  $c_1$  and  $c_2$ . The retail prices of the dominant retailer over both periods are always increasing with  $c_1$  and decreasing with  $c_2$ . The retail prices of the weak retailer are always increasing with  $c_1$  and  $c_2$  in both period. As both retailers' marginal costs raises, due to the change of retail prices, more consumers will choose to shop online and less offline in either period.

#### 4 Channel power and channel-supported network externality

Following the thought of Geylani et al. (2007), to illustrate the impact of channel power on pricing decisions and profits of all firms, we contrast equilibrium outcomes in two related models, one with a dominant retailer who can dictate favourable wholesale terms (which we call it AS model) and one without (which we call it S model). The AS model is already been analysed in sections before and we mainly show the S model in this section.

First when under single period case, because the retailers are identical, the manufacturer will set the same wholesale price for both retailers. Consequently, both retailers' second stage profit is given by  $\pi(R_i) = (p_i - w)(p_d + s - p_i)$ ,  $i = 1, 2$ . And the manufacturer's payoff is  $\pi(M) = w(x_1 + 1 - x_2) + p_d(x_2 - x_1) - F$ . With same solution process as in Liu and Zhang (2006), we then derive the following proposition:

*Proposition 5:* In a single period, the manufacturer will open an online channel only when  $F < \frac{(2-s)^2}{4}$ , and once it is opened, the manufacturer will expropriate the online consumer total surplus by setting the highest direct selling price. Equilibrium is thus characterised by

$$w^* = V - \frac{s}{2}, p^* = V - s, p_1^* = p_2^* = V - \frac{s}{4}, q_1 = q_2 = \frac{s}{4}, q_d = \frac{2-s}{2},$$

$$\pi(M) = V - s + \frac{s^2}{4} - F, \pi_1(R) = \pi_2(R) = \frac{s^2}{16}$$

Obviously, when an online channel is opened, the manufacturer will set the online selling price lower than its wholesale prices or the retail prices, meaning that the wholesale price will be higher than when no online channel has been opened. Hence, the direct internet entry seriously hurts the retailers that must follow suit. If it is convenient to shop online – that is, when the online shopping cost is small enough – the number of online shoppers is much greater than the number of those buying offline, so the manufacturer's willingness to sell online is much higher even when the utility of all consumers purchasing online is zero.

Second, when facing an online channel-supported network externality, by using backward induction, we thus derive the following propositions:

*Proposition 6:* If  $s < \delta$ , no unique equilibrium exists for this sub-game. When  $s > \delta$ , however, the optimal prices and market shares for the manufacturer and retailers in both periods are given by

$$\begin{aligned}
w_1 = w_2 &= V - \frac{s - \delta}{2 - \delta}, p^1 = V - s, \\
p^2 &= V - \frac{2(s - \delta)}{2 - \delta}, p^1 = p^1 = p^2 = p^2 = V - \frac{s - \delta}{2(2 - \delta)}, \\
q^1 = q^2 &= \frac{2 - s}{2 - \delta}, q^1 = q^1 = q^1 = q^2 = \frac{s - \delta}{2(2 - \delta)}, \\
\Pi(M) &= 2V - \frac{4s - s^2 - 2\delta}{2 - \delta}, \Pi(R_1) = \Pi(R_2) = \frac{(s - \delta)^2}{2(2 - \delta)^2}
\end{aligned}$$

Obviously, when both retailers are identical, there is no change in market share across periods for any firm; however, in the second period, the manufacturer's online selling price increases because of the network externality. In such circumstances, the network externality benefits the manufacturer but hurts the retailers because as the degree of network externality increases, the manufacturer's profit level rises but the retailers' profit level declines.

To better illustrate the impact of channel power on the manufacturer's internet entry, we present a comparative analysis here. All firms' equilibriums are presented in Appendix Table A1. For ease of comparison, we let the wholesale price set by the dominant retailer for the manufacturer in both periods equal  $w_1$ . We show the impact of channel power by comparing the equilibriums under the S model with those under the AS model in both the single-period and two-period cases and then assess the impact of the network externality by comparing the single-period equilibriums with the two-period equilibriums under both models.

#### 4.1 Channel power

An analysis of outcomes reveals that when no network externality is considered, a comparison of the single-period equilibriums under the S model with those under the AS model reveals no change in the market share and profit level of  $R_2$ . However, under the AS model, as compared to the S model, if Retailer 1 has the dominant pressure over the manufacturer, the retail prices of both retailers decrease and the market share and profit level of  $R_1$  increase. When a network externality is taken into account, however, a comparison of the two-period equilibriums under the S and AS models clearly shows that the retail prices of both retailers decrease and that the market share and profits of both retailers increase if Retailer 1 is the dominant retailer. In either model, the manufacturer's direct selling price is higher when an online channel network externality is taken into account; however, in the presence of a dominant retailer, the manufacturer's profit is always less whether or not a network externality is considered.

#### 4.2 Channel-supported network externality

When the manufacturer has absolute control over its wholesale prices, given the presence of an online channel network externality, then, compared to the single-period case, the market shares and profits of both retailers decrease while those of the manufacturer increase. Even when the online consumption surplus is zero, more consumers will choose to shop online in the expectation of an online channel network externality. Hence, even though an online channel network externality that benefits the manufacturer seemingly hurts retailers, the expectation of an online channel network externality, in contrast to the findings by Viswanathan (2005), leads retailers to set a higher retail price in both periods. Additionally, under the AS model, when the manufacturer is facing a dominant retailer, in the single period, this retailer dominates more than half the market because its retail price is much lower than under the S model and this abstraction of such a low price increases consumer willingness to buy from this retailer. As a result, the manufacturer's market share is lower than under the S model no matter whether the online channel does or does not provide a network externality. When all firms expect a network externality, retailers set their retail prices lower in both periods than in the single period to compete for consumers.

### 5 Consumer welfare

We first show the impact of a manufacturer's direct entry when a positive online channel network externality is considered under the S model. Before this direct entry, the consumer surplus can be directly calculated to equal  $\frac{1}{4}$ ; afterwards, the consumer total

surplus is  $\frac{s^2}{16}$  in the single-period case, but the consumer surplus per period lowers to

$\frac{(s - \delta)^2}{4(2 - \delta)^2}$  in the two-period case. This observation leads directly to the conclusion that

when the two retailers are symmetric, the manufacturer's direct online entry greatly reduces consumer welfare. Hence, although a network externality seems to add more utility for consumers in the second period, consumers are hurt more by the channel-supported network effect when the manufacturer has absolute control over its wholesale prices. This negative outcome stems primarily from two factors: first, the manufacturer will always exploit the highest consumer surplus from the online channel and second, retailers' prices are higher given the expectation of an online channel network externality.

Under the AS model, in which the dominant retailer dictates its wholesale price to the manufacturer, after the manufacturer's direct online entry, the consumer total surplus per period is  $V - w_1 - \frac{14 + 6s - s^2}{16}$  in the single period case and

$V - w_1 - \frac{56 + 24s - 68\delta - 8s\delta + 19\delta^2 - 4s^2}{16(2 - \delta)^2}$  in the two-period case. Hence, in the presence

of a dominant retailer, the consumer surplus per period is higher in the two-period case

than in the single-period case. In contrast to the outcome under the S model, therefore, consumers do benefit from the online channel-supported network externality.

These comparisons clearly show that in the presence of a dominant retailer with a low retail price, the consumer total surplus is always higher under the AS model than under the S model. Similarly, given the expectation of an online channel network externality, the consumer surplus is higher in the first period than in the second period and consumers do benefit from the network effect.

## **6 Conclusions**

In this paper, we extend Geylani et al.'s (2007) work by analysing a situation in which the manufacturer can add a direct online selling channel to improve its profit level to suggest that online expansion could also be a kind of strategic manufacturer's optimal response to a dominant retailer. Most particularly, we consider the existence of a channel-supported network externality in the online channel and provide a decision-making aid for the manufacturer and its retailers.

We find that when the manufacturer has absolute control over its wholesale prices, it will expropriate the online consumers' total surplus and that even when the net utility is zero, some consumers will still choose to shop online. Under this symmetric case, compared with the single-period retail price, both retailers will set a higher retail price across the two periods. Nevertheless, because the online selling price set by the manufacturer is lower than the retailers' prices, when it is profitable for the manufacturer to add an online selling channel, these two retailers suffer lower profits regardless of whether they are symmetric or asymmetric. When both retailers are symmetric, the unique features offered by the web channels (i.e., the network externality) may hurt consumers; however, consumers do benefit from the presence of a dominant retailer. As the degree of the network externality increases, it benefits the manufacturer but hurts the retailers. We find that when the fixed cost of setting up an online channel and consumers' shopping cost online are not high, the setup of an online channel is always profitable for the manufacturer to deal with the dominant retailer's aggressive wholesale price squeezing, especially when the online channel related network externality is present. But when consumers' online shopping cost is too high, the manufacturer will never open an online channel.

One possible direction for future research would be to better understand the competition among different manufacturers because such competition may significantly impact the strategic decisions of channel members. Another possible avenue – and one that would move beyond our primary focus on the manufacturer's perspective – would be to investigate the reactions of other channel members to a manufacturer's direct online entry and whether, in the presence of a dominant retailer, the manufacturer and retailers bargain over channel profits.

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## References

- Arthur, B.W. (1996) 'Increasing returns and the new worlds of business', *Harvard Business Review*, Vol. 74, No. 4, pp.101–109.
- Arya, A., Mittendorf, B. and Sappington, D.E.M. (2007) 'The bright side of supplier encroachment', *Marketing Science*, Vol. 26, No. 5, pp.651–659.
- Asvanund, A., Clay, K., Krishnan, R. and Smith, M.D. (2004) 'An empirical analysis of network externalities in peer-to-peer music-sharing networks', *Information Systems Research*, Vol. 15, No. 2, pp.155–174.
- Balasubramanian, S. (1998) 'Mail versus mall: a strategic analysis of competition between direct marketers and conventional retailers', *Marketing Science*, Vol. 17, No. 3, pp.181–195.
- Basu, A., Mazumdar, T. and Raj, S.P. (2003) 'Indirect network externality effects on product attributes', *Marketing Science*, Vol. 22, No. 2, pp.209–221.
- Bickart, B. and Schindler, R.M. (2001) 'Internet forums as influential sources of consumer information', *J. Interactive Marketing*, Vol. 15, No. 3, pp.31–40.
- Cattani, K., Gilland, W. and Swaminathan, J. (2004) 'Coordinating traditional and internet supply chains, in supply chain analysis in the e-business era', in Simchi-Levi, D., Wu, D. and Shen, M. (Eds.): *International Series in Operations Research and Management Science*, Kluwer Academic Publishers, Dordrecht.
- Cattani, K., Gilland, W., Heese, H.S. and Swaminathan, J. (2006) 'Boiling frogs: pricing strategies for a manufacturer adding a direct channel that competes with the traditional channel', *Production Oper. Management.*, Vol. 15, No. 1, pp.40–56.
- Chiang, W.K., Chhajed, D. and Hess, J.D. (2003) 'Direct marketing, indirect profits: a strategic analysis of dual-channel supply chain design', *Management Science*, Vol. 49, No. 1, pp.1–20.
- Conner, K.R. (1995) 'Obtaining strategic advantage from being imitated: when can encouraging 'clones' pay?', *Management Science*, Vol. 41, No. 2, pp.209–225.
- Dumrongsiri, A., Fan, M., Jain, A. and Moinzadeh, K. (2008) 'A supply chain model with direct and retail channels', *European Journal of Operational Research*, Vol. 187, No. 3, pp.691–718.
- Geylani, T., Dukes, A.J. and Kannan, S. (2007) 'Strategic manufacturer response to a dominant retailer', *Marketing Science*, Vol. 26, No. 2, pp.164–178.
- Haubl, G. and Trifts, V. (2000) 'Consumer decision making in online shopping environments: the effects of interactive decision aids', *Marketing Science*, Vol. 19, No. 1, pp.4–21.
- Kumar, N. and Ruan, R. (2006) 'On manufacturer's complementing the traditional retail channel with a direct online channel', *Quant. Marketing Econom.*, Vol. 4, No. 3, pp.289–323.
- Liu, Y. (2006) 'Note on self-restraint as an online entry-deterrence strategy', *Management Science*, Vol. 52, No. 11, pp.1799–1809.
- Liu, Y. and Zhang, J.Z. (2006) 'The benefits of personalized pricing in a channel', *Marketing Science*, Vol. 25, No. 1, pp.97–105.
- Pazgal, A. and Soberman, D. (2007) 'Behavior-based discrimination: is it a winning play and if so when?', *Marketing Science*, Vol. 27, No. 6, pp.977–994.
- Prasad, A., Venkatesh, R. and Mahajan, V. (2010) 'Optimal bundling of technological products with network externality', *Management Science*, Vol. 56, No. 12, pp.2224–2236.
- Retail Wire (2012) *Brands Skip Retailers, Go Direct to Consumers*, 1 March [online] <http://www.retailwire.com/discussion/15850> (accessed 20 April 2012).
- Tirunillai, S. and Tellis, G.J. (2011) 'Does online chatter really matter? Dynamics of user-generated content and stock performance', *Marketing Science*, Vol. 31, No. 2, pp.198–215.
- Tomak, K. and Keskin, T. (2008) 'Exploring the trade-off between immediate gratification and delayed network externalities in the consumption of information goods', *European Journal of Operational Research*, Vol. 187, No. 3, pp.887–902.
- Viswanathan, S. (2005) 'Competing across technology-differentiated channels: the impact of network externalities and switching costs', *Management Science*, Vol. 51, No. 3, pp.483–496.

- Xiong, Y., Yan, W., Fernandes, K. et al. (2012) ‘Bricks vs. clicks’: the impact of manufacturer encroachment with a dealer leasing and selling of durable goods’, *European Journal of Operational Research*, Vol. 217, No. 1, pp.75–83.
- Yoo, W.S. and Lee, E. (2011) ‘Internet channel entry: a strategic analysis of mixed channel structures’, *Marketing Science*, Vol. 30, No. 1, pp.29–41.

## Appendix

### *Proof of Proposition 1*

When no online selling channel has been opened, the manufacturer’s profit, as shown by Geylani et al. (2007), is  $w_1 + \frac{3}{8}$ . If an online channel is open, the profit function of  $R_1$  is  $\pi(R_1) = (p_1 - w_1)(p_d + s - p_1)$  and that of  $R_2$  is  $\pi(R_2) = (p_2 - w_2)(p_d + s - p_2)$ . Solving the first-order conditions yields  $p_1 = \frac{1}{2}(p_d + s + w_1)$  and  $p_2 = \frac{1}{2}(p_d + s + w_2)$ . Substituting back into the manufacturer’s profit function, we then obtain

$$\pi(M) = \frac{1}{2} w_1 (p_d + s - w_1) + \frac{1}{2} w_2 (p_d + s - w_2) + p_d \left[ 1 - p_d - s + \frac{w_1 + w_2}{2} \right],$$

$w_2, p_d$   $\square$   $\square$   $\square$   $\square$

which easily leads to  $w_2 = w_1 + 1, p_d = w_1 + \frac{2-s}{2}$ . The manufacturer’s profit is then

$$\pi(M) = w + \frac{2 - 2s + s^2}{4} - F, \text{ so compared to the situation in which there is no online}$$

channel, the manufacturer will open an online channel only when  $F < \frac{2s^2 - 4s + 1}{8}$ .

Although when  $\frac{2 - \sqrt{F}}{2} \leq s < 2$ , the profit of the manufacturer if adding an online

channel is higher than when the online channel has not been opened, the manufacturer’s market share online is negative.

### *Proof of Proposition 2*

In the event that the manufacturer is unable to dictate its wholesale price to the dominant retailer and can only control  $w_2^2$  and  $p_d^2$ , substituting the optimal retail prices of both retailers into the manufacturer’s objective function yields

$$\pi^2(M) = \frac{1}{2} w_2^2 \left( p_d^2 + s - \delta q_d^1 - w_2^2 \right) + \frac{1}{2} w_2^2 \left( p_d^2 + s - \delta q_d^1 - w_2^2 \right) + p_d^2 \left[ 1 - \left( p_d + s - \delta q_d - w_1 \right) - \left( p_d + s - \delta q_d - w_2 \right) \right]$$

By solving the first-order conditions, we then obtain  $p^2 = \frac{1}{2}(2w^2 + 2 - s + \delta q^1)$ ,

$$w_2^2 = w_1^2 + 1.$$

The total profit over two periods for the manufacturer is:

$$\begin{aligned} \pi(M) = & \frac{1}{2} w_1^1 (p^1 + s - w_1^1) + \frac{1}{2} w_1^1 (p^1 + s - w_1^1) + p^1 \frac{1}{2} (1 - p^1 - s) + \frac{1}{2} w_1^1 + \frac{1}{2} w_1^1 \\ & + \frac{1}{2} w_1^1 (1 + s - \delta(1 - p_d - s) - w_1 + w_2) \\ & + \frac{1}{2} (s - p^1 - s + w_1 + w_1) \\ & + \frac{1}{4} (2w^2 + 2 - s + \delta(1 - p^1 - s) + w_1 + w_1) \\ & + \frac{1}{4} (1 - s + \delta(1 - \beta - s) + w_1 + w_2) \end{aligned}$$

After computing first order condition, the optimal first period wholesale price for Retailer 2 and direct selling price online are given by:

$$w_2^1 = w_1^1 + 1, p_d^1 = w_1^1 + \frac{4 - 3\delta - 2s(1 - \delta)}{2(2 - \delta)}.$$

### Proof of Proposition 3

The retailers' optimal retail prices are:

$$p_i = \frac{1}{2}(p_d + s - w_i - c_i), i = 1, 2$$

By substituting them back into manufacturer's profit function, we derive:

$$\begin{aligned} \pi(M) = & \frac{1}{2} w_1 (p_d + s - w_1 - c_1) + \frac{1}{2} w_2 (p_d + s - w_2 - c_2) \\ & + p_d \frac{1}{2} (1 - p_d - s) + \frac{1}{2} (w_1 + c_1 + w_2 + c_2) \end{aligned}$$

After first order condition, the wholesale price for Retailer 2 and the online selling price are given by:

$$p_d = w_1 + \frac{1}{2}c_1 + \frac{2-s}{2} > w_1 + \frac{2-s}{2}, w_2 = w_1 + 1 - \frac{1}{2}(c_2 - c_1) < w_1 + 1$$

Therefore, the maximised profit of the manufacturer is:

$$w + \frac{1}{8} \left( (c - s)^2 + (c - s)^2 + 4(1 - s) + 4c \right) - F.$$

With the same solution process, the manufacturer's profit without internet entry is

$$w_1 + \frac{(3 - c_2 + c_1)^2}{24}.$$

The market share of the weak retailer when manufacturer decides to open online channel is  $\frac{s - c_2}{4}$ . So when  $s < c_2$ , the weak retailer will be driven out of market.

#### *Proof of Proposition 4*

The computing process is the same as that in the proof of Proposition 2.

#### *Proof of Proposition 5*

Before the manufacturer opens the online channel, because the two retailers are identical, their retail prices and market share are the same. The marginal consumer, obviously, is located at the middle of the line; the left-side consumers will buy from  $R_1$ , and the right-side consumers will buy from  $R_2$ .  $R_1$  will set its retail price so that  $V - x - p_1 = 0$ , which allows us to derive the profit function of  $R_1$ :  $\pi(R_1) = (p_1 - w)(V - p_1)$ . By

solving the first-order condition, we obtain an optimal value of  $p_1$ :  $p_1 = \frac{1}{2}(V + w)$ . Then

$$x = \frac{1}{2}(V - w), \quad \pi(M) = w(V - w), \quad \text{with the first-order condition that } w = \frac{1}{2}V, x = \frac{V}{4} > \frac{1}{2}.$$

Given  $V > 4$ , the manufacturer will set its wholesale price to ensure that the retailers just cover the market; that is,  $x = \frac{1}{2}$ . It will thus set  $w = V - 1$  and  $\pi(M) = V - 1$ .

After the manufacturer has opened the online channel, if it sets the wholesale price to  $w \geq V$ , the retailers cannot make any sale profitably and the manufacturer will only sell online. Then the manufacturer's profit is  $\pi(M) = V - s - F$ . If  $w < V$ ,

meaning that, as shown above,  $p_1 = p_2 = \frac{1}{2}(p_d + s + w)$ , the manufacturer's payoff is

$\pi(M) = w(p_d + s - w) + p_d(1 - p_d - s + w)$ , and its optimal direct selling price is

$$p_d = \frac{1}{2}(1 - s + 2w). \quad \text{Because } p_d \leq V - s, \text{ we must have } w \leq V - \frac{1}{2}(1 + s). \quad \text{Therefore, when}$$

$V - \frac{1}{2}(1 + s) < w < V$ , the online selling price is always  $p_d = V - s$ , and the manufacturer's

profit can be summarised as follows:

$$\begin{aligned} \clubsuit \quad & w + \frac{(1-s)^2}{4} - F, & \text{if } 0 < w < V - \frac{1}{2}(1+s) \\ \spadesuit \quad & & \\ \heartsuit \quad & -w^2 + (2V-s)w - (V-s)(V-1) - F, & \text{if } V - \frac{1}{2}(1+s) \leq w < V \\ \blackheartsuit \quad & V - s - F, & \text{if } w \geq V \end{aligned}$$

The equilibrium in this sub-game is therefore given by



$$w = V - \frac{1}{2}s, p = V - s, p = p = V - s, \pi(M) = V - s + \frac{s^2}{4} - \frac{F}{4}$$

Comparing the manufacturer's profit when the online channel is opened versus when it is not, the difference is  $\Delta\pi(M) = 1 - s + \frac{s^2}{4} - F$ . Hence, when  $\Delta\pi(M) > 0$ , the manufacturer will open an online channel.

*Proof of Proposition 6*

The second-period objective functions for the two retailers are  $\pi(R_1) = (p^2 - w_2)(p^2 + s - \delta q^1 - p^2)$  and  $\pi(R_2) = (p^2 - w_2)(p^2 + s - \delta q^1 - p^2)$  respectively. After solving the first-order condition, we get

$$p^2 = p^2 = \frac{1}{2}(p^2 + s - \delta q^1 + w_2), x^2 = 1 - x^2 = \frac{1}{2}(p^2 + s - \delta q^1 - w_2).$$

Substituting this solution into the manufacturer's objective function yields

$$\pi(M) = w_2 (p^2 + s - \delta q^1 - w_2) + p^2 (1 - p^2 - s + \delta q^1 + w_2)$$

Because it is impossible to derive an optimal first-order condition for the above function, however, we discuss the manufacturer's second-period profit in terms of the alteration in its wholesale price. First, its optimal online selling price is  $p^2 = \frac{1}{2}(1 - s + 2w_2 + \delta q^1)$ , so, because  $p^2 \leq V - s + \delta q^1$ , we have  $w_2 \leq V - \frac{1}{2}(1 + s - \delta q^1)$ . When  $V - \frac{1}{2}(1 + s - \delta q^1) < w_2 < V$ , then the optimal online selling price is  $p^2 = V - s + \delta q^1$  and if  $w_2 > V$ , the manufacturer will only sell online. The sub-game can thus be summarised as

$$\pi(M) = \begin{cases} \frac{(1 - s + \delta q^1)^2}{4}, & \text{if } w_2 < V - \frac{1}{2}(1 + s - \delta q^1) \\ -w_2 + (2V - s + \delta q^1)w_2 - (V - s + \delta q^1)(V - 1), & \text{if } V - \frac{1}{2}(1 + s - \delta q^1) \leq w_2 < V \\ V - s + \delta q^1, & \text{if } w_2 \geq V \end{cases}$$

and its equilibrium is given by

$$w_2 = V - \frac{1}{2}s + \frac{1}{2}\delta q^1, p^2 = V - s + \delta q^1, p^2 = p^2 = \frac{1}{2}(2V - s + \delta q^1)$$

Table A1  
Equilibrium values

Cases and equilibriums	Two-period equilibriums in the S model	Two-period equilibriums in the S model	Single-period equilibriums in the AS model	Two-period equilibriums in the AS model
$q(R_1)$	$\frac{s}{4}$	$\frac{s - \delta}{2(2 - \delta)}$	$\frac{2 + s}{4}$	$\frac{4 + 2s - 3\delta}{4(2 - \delta)}$
$q(R_2)$	$\frac{s}{4}$	$\frac{s - \delta}{2(2 - \delta)}$	$\frac{s}{4}$	$\frac{2s - \delta}{4(2 - \delta)}$
$q(M)$	$1 - \frac{s}{2}$	$\frac{2 - s}{2 - \delta}$	$\frac{1 - s}{2}$	$\frac{1 - s}{2 - \delta}$
$p(R_1)$	$V - \frac{s}{4}$	$V - \frac{s - \delta}{2(2 - \delta)}$	$w + \frac{2 + s}{4}$	$w + \frac{4 + 2s - 3\delta}{4(2 - \delta)}$
$p(R_2)$	$V - \frac{s}{4}$	$V - \frac{s - \delta}{2(2 - \delta)}$	$w + \frac{4 + s}{4}$	$w + \frac{8 - 5\delta + 2s}{4(2 - \delta)}$
$p_d^1$	$V - s$	$V - s$	$w + \frac{2 - s}{2}$	$w + \frac{4 - 3\delta - 2s(1 - \delta)}{2(2 - \delta)}$
$p_d^2$	—	$V - \frac{2(s - \delta)}{2 - \delta}$	—	$w + \frac{4 - \delta - 2s}{2(2 - \delta)}$
$\Pi(R_1)$	$\frac{s^2}{16}$	$\frac{(s - \delta)^2}{2(2 - \delta)^2}$	$\frac{(2 + s)^2}{16}$	$\frac{(4 + 2s - 3\delta)^2}{8(2 - \delta)^2}$
$\Pi(R_2)$	$\frac{s^2}{16}$	$\frac{(s - \delta)^2}{2(2 - \delta)^2}$	$\frac{s^2}{16}$	$\frac{(2s - \delta)^2}{8(2 - \delta)^2}$
$\Pi(M)$	$V - s + \frac{s^2}{4} - F$	$2V - \frac{4s - 2\delta - s^2}{2 - \delta} - F$	$w_1 + \frac{2 - 2s + s^2}{4} - F$	$2w + \frac{4 - 4s + 2s^2 - \delta}{2(2 - \delta)} - F$