Retail channel management with product differentiation

H. Gülçin Uğur

Bosch Turkey

Özgen Karaer

Middle East Technical University

okaraer@metu.edu.tr

Abstract

We analyze a monopolist retailer's channel management decisions in a product differentiation context. Historically, retailers developed a physical outlet presence after developing their primary brand chain. Here, we evaluate the online channel decisions of a retailer and its interaction with the physical channels available; possibly both primary and outlet chains.

Keywords: Online Channel, Product Differentiation, Retail

INTRODUCTION

Factory outlet stores were initially designed and utilized by manufacturers as a means to dispose of closeouts, irregulars, damaged merchandise, excess inventory, and etc., mostly in locations adjacent to the factory itself. Today, factory outlet stores and other off-price stores are gathered in value retail centers, or outlet malls, located about an hour's drive from city centers. Since 1990s, value retail concept has been one of the fastest growing segments in the United States (Segel 2002, Soysal and Krishnamurthi 2015). In fact, by 2000, there were 278 outlet centers in the United States with 13,564 stores (Segel 2002). Today, outlet centers are crowded by not only manufacturer-operated factory stores, but also retailer-owned outlet stores.

The main reason for this fast growth is the market expansion, price discrimination, and profit opportunity an outlet channel presents for a retailer. Nowadays, outlet stores, parallel to traditional stores, comprise an alternative sales channel that offers a lower quality option of the original collection. For example, Coach, Nordstrom, Saks outlet stores sell goods 80% of which are

exclusively designed for the outlet channel (Soysal and Krishnamurthi 2015). Ann Taylor, Guess, J.Crew, Gap, Banana Republic, Talbots, and Gymboree similarly design and source their own lines for the outlet branch (Levy and Weitz 2012, Soysal and Krishnamurthi 2015). Thus, the outlet store represents an opportunity to expand the market of a retailer through vertical differentiation.

Direct selling channels, as an alternative to the brick-and-mortar stores, include catalog business, online stores and mobile stores. As the use of Internet and smart phones increases every day, multichannel retailing, especially the online channel, is starting to represent a significant portion of sales. With the emergence of e-commerce in the late '1990s and early '2000s, the online store has been adopted as a direct channel by retailers. Chains like Gap Inc., J. Crew and many others already had a mature outlet store concept before the online store came along.

From the viewpoint of the retailer, online retailing has many advantages. Online channel provides a retailer means for reaching more customers, and potentially serving them through a wider assortment. The consumer is free of the physical inconvenience of the visit and the risk of out-of-stock that he may face at the store. However, with online purchases, the consumer has to endure the risks with the fit, color, and fabric/material of the product. Most important, immediate gratification is not possible anymore; the consumer has to patiently wait for his product in addition to other risks associated with buying online (credit card use and risk, wrong shipments, return issues, and etc.). Thus, an online store's value for a customer is directly linked with many attributes of that channel, such as the delivery speed, reliability, shipping charges, online customer services, and return processing.

Recently, we observe retailers with outlet branches and online stores making their outlet stores available online as well – basically opening a second channel for their "value" business. Nordstrom's e-commerce site Nordstromrack.com provides its consumers with off-price fashion products online. REI offers its consumers both options of "Shop REI" and "Shop REI Outlet" in its e-commerce site www.rei.com. J.Crew offers a link at www.jcrew.com to the online J. Crew Factory Store, but only at the weekends. Gap, Banana Republic, and Coach have similar outlet sites.

With this fast evolution in retail channels in the last couple decades, one wonders if retailers should take into account their outlet store chains while making direct channel commitments. Similarly, whether the online outlet store is in fact a new profit center or a fully competitive move is an intriguing question. In this paper, we study the interaction of the direct channel decisions of a retailer with his outlet business. Specifically, we characterize the impact of the outlet chain on the online store decisions. We also investigate what market conditions motivate a retailer to open a direct channel for the outlet business. To focus on a firm's own motives, we study a monopolist retailer and his decisions.

In our study, we use vertical differentiation to model the interaction between the primary brand and the outlet branch. It is common that the outlet branch offers the product with lower quality, provides lower services, but charges a lower price compared to the primary brand stores. The quality we use here may represent the extent the retailer invests in the material, design and originality of the product sold at the outlet store as well as the services available at its stores.

We first review the relevant literature in the next section, followed by the Model Overview section. We present our findings in the Analysis section and then conclude the paper.

LITERATURE REVIEW

In this work, we study a monopolist retailer's channel decisions jointly with his vertical product differentiation strategy. In this respect, our work is closely related with two streams of research: (vertical) product differentiation and retailer channel management.

Literature on product differentiation: Hotelling (1929) considers a simple model of horizontal differentiation; consumers are distributed uniformly on a "linear city" of length 1 and two firms compete on store location and price. Moorthy (1988) studies vertical differentiation a la Hotelling to investigate the competitive product strategy of firms. Desai (2001) investigates whether cannibalization affects a firm's product and price decisions by studying a market that is both vertically and horizontally differentiated. Product line design and new product introduction problems (e.g. Moorthy 1984, 1987, Moorthy and Png 1992, Purohit 1994, Ferguson and Koenigsberg 2007, and Kim et al. 2013) share the same vertical differentiation approach as in our work. In addition to these, Vadenbosch and Weinberg (1995) and Lauga and Ofek (2011) utilize two-dimensional vertical differentiation models as we do, but in a competitive setting. Though our work differs in the problem setting and/or the research questions from each work listed here, our modeling approach shares the same market assumptions with this stream of the literature.

Literature on retail channel management: Chen, Kaya and Özer (2008) study a manufacturer's direct online sales channel and an independently owned brick-and-mortar retailer channel when channels compete on service. The authors characterize the optimal dual channel strategies that depend on the channel environment. In modeling the online channel decision, we adopt the model used by Chen et al. (2008); a customer base heterogeneous in sensitivity to online service quality (e.g., willingness to wait) and a cost structure with diminishing returns in setting the online service quality (delivery time).

Tsay and Agrawal (2004) investigate channel conflict and coordination in a supply chain of a manufacturer and a reseller. Zhang (2009) studies a retailer's adoption of a multichannel strategy in connection with price advertising. Song and Zheng (2008) model a supply chain channel structure in a competitive oligopoly setting to investigate the "click-and-mortar" business model. Liu, Gupta and Zhang (2006) study an entry-deterrence problem where the brick-and-mortar retailer, as the incumbent, may open his direct channel to deter an e-tailer. Subramanian (1998) studies competition between direct marketers and conventional retailers. Coughlan and Soberman (2005) study a duopoly model where two manufacturers serve their consumers through the primary retailers or with dual distribution (primary retailers and outlet stores).

All papers above study potential issues and opportunities with the emergence of the online store as a secondary channel for retailers, and a direct channel for manufacturers. We complement this literature by studying a recent practice observed in the retail industry. We investigate how product differentiation decisions are interrelated with the online channel decisions and study what kind of market conditions would render an outlet online channel decision profitable.

MODEL DETAILS

A retailer offers two lines of products; primary brand and its outlet version. Outlet stores offer a lower quality/service, lower price option to the customer. The primary label is denoted with quality s_1, price p_1 whereas the outlet product is positioned at quality s_2, price p_2, where $s_1 > s_2$ and

$p_1 > p_2$. Outlet product also represents a higher physical inconvenience to the customers. Original store chain is well penetrated into the market whereas outlet stores are located in outlet malls, farther from the city center, in areas of low value real estate.

Each consumer may buy a primary label product, an outlet product, or nothing at all. Consumers differ in their willingness to pay for quality. To model this heterogeneity, we assume that the consumers are uniformly distributed along a line; $\theta \sim U[0, b]$. The retailer may serve customers through an online (direct) channel in addition to the brick-and-mortar chain. The direct channel rids the consumer off the physical inconvenience of visiting a store but offers new complications. A customer's utility from purchasing online changes with the delivery time, risk associated with the fit and color of the product, and the return processes involved. We refer to this overall performance as ``online service quality'' and refer to it with *t* with an inverse connotation. Thus, the lower the *t*, the higher the online quality services, and the higher the utility of the customer from purchasing online. Consumers also differ in their sensitivity to the ``online service quality.'' Thus, any consumer in the market is indexed by a pair (θ, d), both of which are uniformly distributed on $[0, b]$. A consumer will purchase the product from the channel that produces the highest utility for him. If none offers a utility higher than his reservation utility (which we assume is 0), he will not purchase at all. A consumer's utility from purchase decisions is summarized as below:

$$U(\theta, d) = \begin{cases} \theta s_1 - p_1 - k, & \text{if he purchases from the primary brand physical store} \\ \theta s_2 - p_2 - m, & \text{if he purchases from the outlet physical store} \\ \theta s_1 - p_1 - dt, & \text{if he purchases from the primary brand online store} \\ 0, & \text{otherwise} \end{cases}$$

Here *m* and *k* represent the physical inconvenience of visiting a store; where $m \geq k > 0$. The retailer's unit product cost increases with the product's quality level. The retailer incurs an additional service cost for each customer served through the online channel. The higher the online service quality offered, the higher the unit service cost. Here we use quadratic functions to represent diminishing returns on product quality and online services. Thus, the unit gross margin for the original and outlet branches in the physical chain are $p_1 - cs_1^2$ and $p_2 - cs_2^2$, respectively. When customers purchase online, the unit gross margins also decrease by $\frac{z}{t^2}$. The notation we use in our model is summarized in Table 1 below.

Table 1: Notation

Product/Channel Parameters	
s_i	Quality level of the primary label (outlet) product; *i=1,2*
p_i	Price of the primary label (outlet) product; *i=1,2*
k	Physical inconvenience of visiting a store of the original label chain; *k>0*
m	Physical inconvenience of visiting a store of the outlet chain; *m>0*
θ	A consumer's marginal willingness-to-pay for quality; $\theta \sim U[0, b]$
d	A consumer's sensitivity to online service quality & delivery time;, $d \sim U[0, b]$
Cost Parameters	
c	Unit cost coefficient associated with product quality; *c>0*
z	Unit cost coefficient associated with online services; *z>0*
Decision Variable	
t	Online service quality; $t \in [\underline{t}, \bar{t}]$

ANALYSIS

In this section, we first characterize the market effect of opening an online channel for a retailer and his optimal online service quality decision. We first consider a retailer with a primary brand brick-and-mortar chain only, and later a retailer that has both primary and outlet physical chains. Throughout our analysis, we assume all channels are viable; i.e., they have nonnegative demand ($b-\frac{k}{\underline{t}}>0,\ b-\frac{m}{\underline{t}}>0,\ b-\frac{p_1+k}{s_1}\geq 0,\ \left(b-\frac{p_1-p_2+k-m}{s_1-s_2}\right)\geq 0, \left(\frac{p_1-p_2+k-m}{s_1-s_2}-\frac{p_2+m}{s_2}\right)\geq 0,\ \left(b-\frac{p_1-p_2}{s_1-s_2}\right)\geq 0$); both primary and outlet businesses are profitable ($(p_1-cs_1^2)>0, (p_2-cs_2^2)>0$); and the online service cost is sufficiently high for the retailer to avoid infinitely high online service targets (i.e., $z>\max(\frac{(\bar{t})^2k(p_1-cs_1^2)}{6(2bs_1-2p_1-k)}, \frac{(\bar{t})^2k(p_1-cs_1^2-(p_2-cs_2^2))}{6(2bs_1-2bs_2-2p_1+2p_2+2m-k)})$).

Retailer with a Primary Physical Channel

Proposition 1: For a retailer that has the primary physical channel and an online channel with service level *t (t>0)*, the demand for the physical and online channels are $\left(\mathrm{b}-\frac{k}{t}\right)(\mathrm{b}-\frac{\mathrm{p_1+k}}{\mathrm{s_1}})$ and $\frac{k}{2t}(2b-\frac{p_1+k}{s_1}-\frac{p_1}{s_1})$, respectively. Without an online channel, the retailer's demand would be $\mathrm{b}\left(\mathrm{b}-\frac{\mathrm{p_1+k}}{\mathrm{s_1}}\right)$.

Proposition 2: The retailer with the primary physical channel only sets $t^*=\min(\max(t^\circ,\underline{t}),\bar{t})$ where $t^\circ=\sqrt{\frac{3z(2bs_1-2p_1-k)}{k(p_1-cs_1{}^2)}}$ at the online channel to maximize his total profit. If $z<\frac{\mathrm{k(p_1-cs_1^2)(\bar{t})^2}}{3\,(2bs_1-2p_1-k)}$, the retailer's total profit increases with the online channel.

The retailer's main tradeoff is between market expansion and cannibalization of the physical channel and the online store margin loss. As *k* or p_1 increases, market expansion starts to dominate, hence t° decreases. As *z* or *c* increases, loss in the profit margin dominates, hence t° increases. Intuitively, as *k* increases, the physical channel's demand potential shrinks. Thus, the online channel presents a bigger market expansion opportunity for the retailer. Then he targets a higher online service quality to effectively capture a bigger market. As p_1 increases, the higher margin and the depressed market potential encourage the retailer to set high online service targets. When the online service cost is low enough, the new market generated through the online channel is larger and opening the online channel is always profitable for the retailer.

Retailer with Primary and Outlet Physical Channels

Proposition 3: For given given (p_1, s_1,*k*), (p_2, s_2,*m*) and *t*, the retailer's demand by channel can be characterized as follows:

i. Case 1: if $\theta_1=\frac{\mathrm{p_2+m}}{\mathrm{s_2}}\leq\theta_2=\frac{\mathrm{p_1}}{\mathrm{s_1}}\leq\theta^*=\frac{\mathrm{p_1-p_2-m}}{\mathrm{s_1-s_2}}$

$D_1=\left(b-\frac{p_1-p_2+k-m}{s_1-s_2}\right)(b-\frac{k}{t})$ for the primary physical channel,

$D_2=\frac{1}{2}\left(2b-\frac{k}{t}\right)\left(\frac{k}{s_1-s_2}\right)+b\left(\frac{p_1-p_2-m}{s_1-s_2}-\frac{p_2+m}{s_2}\right)$ for the outlet physical channel, and

$D_3 = \left(2b - \frac{2p_1 - 2p_2 + k - 2m}{s_1 - s_2}\right)\left(\frac{k}{t}\right)\frac{1}{2}$ for the online channel. Here, the retailer's total demand does remain the same after opening the online channel.

ii. Case 2: if $\theta_1 = \frac{p_2 + m}{s_2} > \theta_2 = \frac{p_1}{s_1} > \theta^* = \frac{p_1 - p_2 - m}{s_1 - s_2}$

$D_1 = \left(b - \frac{p_1 - p_2 + k - m}{s_1 - s_2}\right)(b - \frac{k}{t})$ for the primary physical channel

$D_2 = \frac{1}{2}\left(\frac{p_1 - p_2 + k - m}{s_1 - s_2} - \frac{p_2 + m}{s_2}\right)(2b - \frac{k}{t} - \frac{s_1 p_2 + s_1 m - p_1 s_2}{s_2 t})$ for the outlet physical channel

$D_3 = \frac{1}{2}\left(\frac{s_1 p_2 + s_1 m - p_1 s_2}{s_2 t}\right)\left(\frac{p_2 + m}{s_2} - \frac{p_1}{s_1}\right) + \frac{1}{2}\left(\frac{s_1 p_2 + s_1 m - p_1 s_2}{s_2 t} + \frac{k}{t}\right)$
$\left(\frac{p_1 - p_2 + k - m}{s_1 - s_2} - \frac{p_2 + m}{s_2}\right) + \left(b - \frac{p_1 - p_2 + k - m}{s_1 - s_2}\right)\frac{k}{t}$ for the online store. Here, the online channel expands the retailer's total demand.

Figure 1 and 2 summarize the change in the retailer's total demand with the opening of the online channel for Cases 1 and 2, respectively.

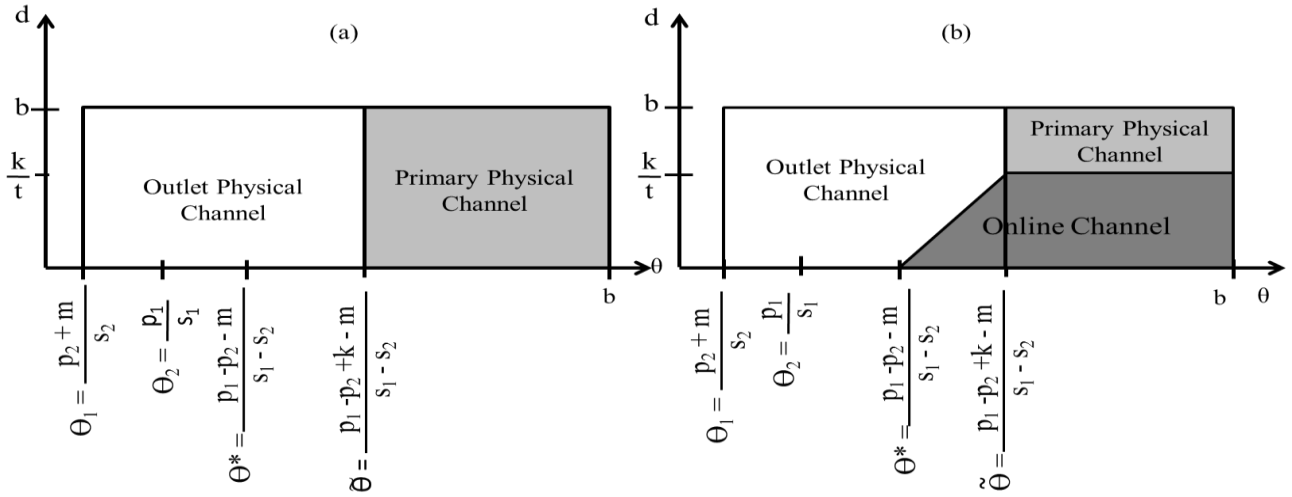

Figure 1: Retailer's demand without (a) and with (b) the online channel - Case 1

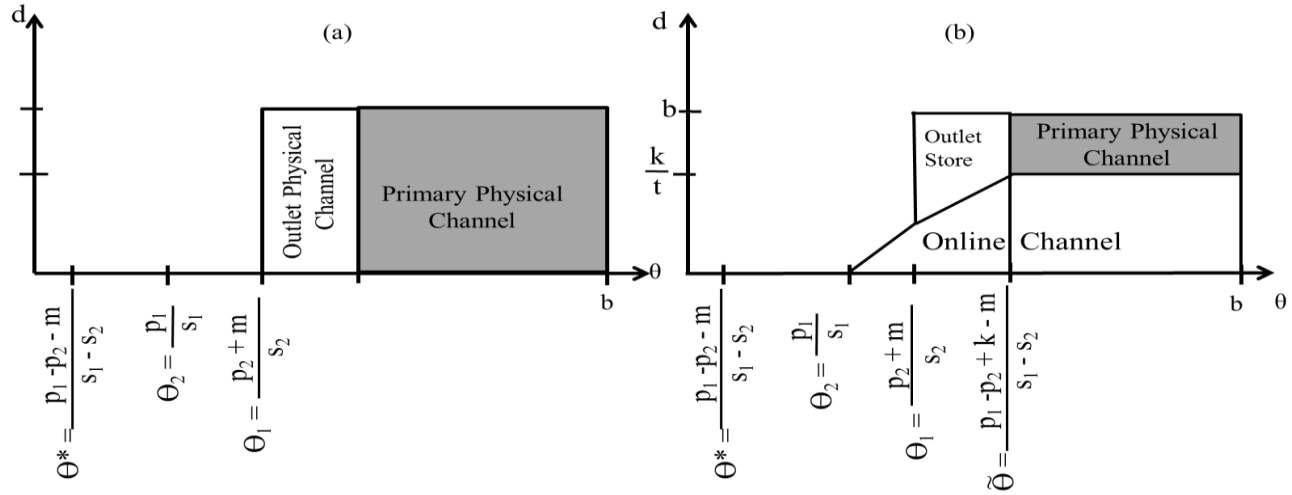

Figure 2: Retailer's demand without (a) and with (b) the online channel - Case 2

Proposition 4: a) Under Case 1:

i. If $(p_1 - cs_1^2) - (p_2 - cs_2^2) < 0$, the retailer will set the online service level as high as possible (i.e., $\bar{t}$) and never find it profitable to open the online channel.

ii. If $(p_1 - cs_1^2) - (p_2 - cs_2^2) > 0$, the retailer sets t^* =min $(\max(t^\circ, \underline{t}), \bar{t})$ where $t^\circ = \sqrt{\frac{3z(2bs_1 - 2bs_2 - 2p_1 + 2p_2 + 2m - k)}{k\left((p_1 - cs_1^2) - (p_2 - cs_2^2)\right)}}$. Online channel increases the retailer's profit if and only if $z \leq \frac{k[(p_1 - cs_1^2) - (p_2 - cs_2^2)](\bar{t})^2}{(2bs_1 - 2bs_2 - 2p_1 + 2p_2 + 2m - k)}$.

b) Under Case 2: Define $y = s_1 p_2 + s_1 m - p_1 s_2$, $\tilde{\theta} = \frac{p_1 - p_2 + k - m}{s_1 - s_2}$, $\theta_1 = \frac{p_2 + m}{s_2}$, and $\theta_2 = \frac{p_1}{s_1}$

iii. If $(p_1 - cs_1^2)\left(ks_2(\tilde{\theta} - \theta_1) + y(\tilde{\theta} - \theta_2)\right) - (p_2 - cs_2^2)(\tilde{\theta} - \theta_1)(y + ks_2) < 0$, then the retailer will set the optimal delivery time as high as possible (i.e., $\bar{t}$) and never find it profitable to open the online channel.

iv. If $(p_1 - cs_1^2)\left(ks_2(\tilde{\theta} - \theta_1) + y(\tilde{\theta} - \theta_2)\right) - (p_2 - cs_2^2)(\tilde{\theta} - \theta_1)(y + ks_2) > 0$ holds (which is directly guaranteed when $(p_1 - cs_1^2 - (p_2 - cs_2^2) > 0)$, then the retailer $t^* = \min(\max(t^\circ, \underline{t}), \bar{t})$ where $t^\circ = \sqrt{\frac{3z[ks_2(2b - \tilde{\theta} - \theta_1) + y(\tilde{\theta} - \theta_2)]}{\left[(p_1 - cs_1^2)\left(ks_2(\tilde{\theta} - \theta_1) + y(\tilde{\theta} - \theta_2)\right) - (p_2 - cs_2^2)(\tilde{\theta} - \theta_1)(y + ks_2)\right]}}$. Online channel increases the retailer's profit if and only if $z \leq \frac{\left[(p_1 - cs_1^2)\left(ks_2(\tilde{\theta} - \theta_1) + y(\tilde{\theta} - \theta_2)\right) - (p_2 - cs_2^2)(\tilde{\theta} - \theta_1)(y + ks_2)\right](\bar{t})^2}{[ks_2(2b - \tilde{\theta} - \theta_1) + y(\tilde{\theta} - \theta_2)]}$.

The profitability of the online channel hinges on two factors: profit margins of the primary and outlet businesses, and the online service cost. For profitability, the lost margin of the cannibalized customers from both physical chains must be compensated by the increased margin by the transition of customers from outlet to the online store and by the newly acquired customers. This creates a tighter pressure on margin for cases where the online channel only cannibalizes the physical chain's customers (e.g. Case 1). When the online store generates a market expansion as well (e.g. Case 2), the retailer can tolerate lower primary business margins to increase his profit through the online channel.

The Online Outlet Channel Decision

When opening the outlet online channel, we assume that the retailer has to sustain the same standards as he sets for the primary online channel (due to reasons such as sharing the same website, same resources, and etc.). Thus, the retailer will use the service quality (t) already determined when opening the primary online channel. In terms of product, the retailer will stay consistent with the quality level and price available at the outlet physical channel. Thus, at this stage, the retailer only needs to evaluate whether it is profitable to open the online outlet channel with his current commitments.

Proposition 5: For a given (p_1, s_1,k), (p_2, s_2,m) and t, the total demand of the retailer and its split across the channels are as below:

$D_1 = \left(b - \frac{p_1 - p_2 + k - m}{s_1 - s_2}\right)\left(b - \frac{k}{t}\right) - \frac{0.5\,(m-k)^2}{t(s_1 - s_2)}$ for the primary physical channel

$D_2 = \left(\frac{p_1 - p_2 + k - m}{s_1 - s_2} - \frac{p_2 + m}{s_2}\right)(b - \frac{m}{t})$ for the outlet physical channel

$D_3 = \left(b - \frac{p_1 - p_2}{s_1 - s_2}\right)\frac{k}{t}$ for the primary online channel, and
$D_4 = \left(\frac{2(p_1 - p_2 + k - m)}{s_1 - s_2} - \frac{p_2 + m}{s_2} - \frac{p_2}{s_2}\right)\frac{0.5m}{t} + \frac{0.5(m-k)(m+k)}{t(s_1 - s_2)}$ for the outlet online channel. Under all cases, opening the online outlet channel expands the retailer's total market at the expense of cannibalization of other channels.

Figure 3 and 4 below describe the retailer's demand composition across channels for Case 1 and 2, respectively (as described in Proposition 3).

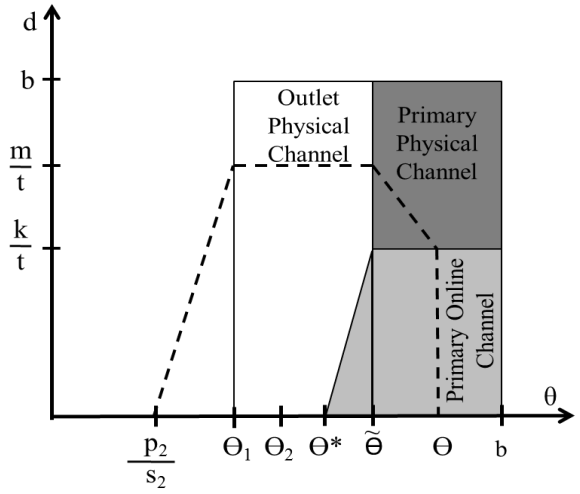

Figure 3: Retailer's demand after the introduction of the online outlet channel (and its split among channels) for Case 1 (where $\theta_1 = \frac{p_2+m}{s_2}$, $\theta_2 = \frac{p_1}{s_2}$, $\theta^* = \frac{p_1-p_2-m}{s_1-s_2}$, $\tilde{\theta} = \frac{p_1-p_2+k-m}{s_1-s_2}$, *and* $\theta = \frac{p_1-p_2}{s_1-s_2}$ *)*

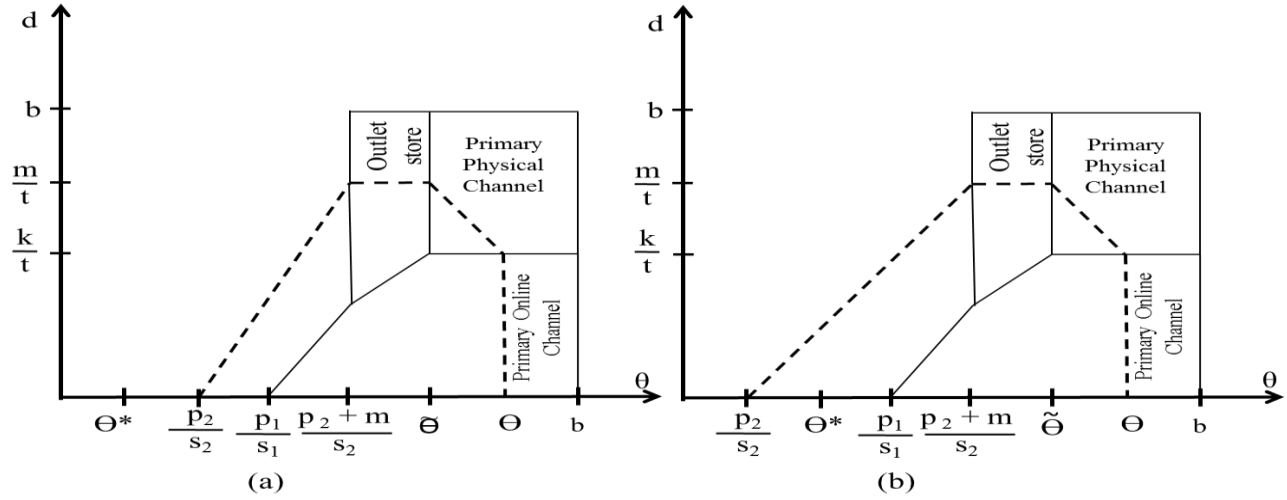

Figure 4: Retailer's demand after the introduction of the online outlet channel (and its split among channels) for Case 2 when $\tilde{\theta}>\theta_1>\theta_2>\theta_3>\theta^*$ *(a) and* $\tilde{\theta}>\theta_1>\theta_2>\theta^*>\theta_3$ *(b) (where* $\theta_1 = \frac{p_2+m}{s_2}$, $\theta_2 = \frac{p_1}{s_2}$, $\theta^* = \frac{p_1-p_2-m}{s_1-s_2}$, $\tilde{\theta} = \frac{p_1-p_2+k-m}{s_1-s_2}$, *and* $\theta = \frac{p_1-p_2}{s_1-s_2}$*)*

Proposition 6: Let $z_1 = \frac{t^2 m[s_1(p_2 - cs_2^2) - s_2(p_1 - cs_1^2)]}{2(s_2 p_1 - s_1 p_2 - 0.5 m s_1)}$ and

$$z_2 = \frac{t^2[-\left(\frac{(m^2-k^2)}{(s_1-s_2)}+\frac{ks_2(\tilde{\theta}-\theta_1)+y(\tilde{\theta}-\theta_2)}{s_2}\right)(p_1-cs_1^2)+\left(\frac{(m^2-k^2)}{(s_1-s_2)}+\frac{m^2+(\tilde{\theta}-\theta_1)(y+ks_2)}{s_2}\right)(p_2-cs_2^2)]}{[(2m-k)(\tilde{\theta}-\theta_1)+\frac{(m-k)^2}{(s_1-s_2)}+\frac{m^2-y(\tilde{\theta}-\theta_2)}{s_2}]}$$

For a given (p_1, s_1), (p_2, s_2) and t,

i. If the online service cost is smaller than z_1, then opening the online outlet channel is profitable for the retailer under Case 1.
ii. If the online service cost parameter of the market environment is smaller than z_2, then opening the online outlet channel is profitable for the retailer under Case 2.

CONCLUSION

In this paper, we analyze the online channel decisions of a retailer and its interaction with the presence of a second value chain; i.e., the physical outlet channel. Online channel gives the retailer an opportunity to expand his market in many cases, at the expense of additional online services and related costs. For a retailer with a primary physical chain only, the online channel always expands his market and brings him extra profits if the online service cost is high enough.
When the retailer is vertically differentiated, and manages both the primary and outlet physical channels, the online store may or may not expand his total market. Here, the primary brand online store may only cannibalize the primary and outlet physical channels. If the primary business has high enough margins, however, the retailer may still find it profitable to open the online channel and induce some customers to switch from the outlet channel to the online store.

The outlet online store always expands a retailer's total market. Surprisingly, the profitability of this channel is quite possible even when the online outlet channel ends up cannibalizing the other three channels. Here, the value of the new channel hinges on the relative margin power of the two channels and the online service cost.

In this study, we studied a monopolist retailer to focus on the profit value of the new channels from an individual retailer's perspective. The same analysis in a competitive environment would be an interesting extension to the problem. Here we conjecture that the pressure of competition would further incentivize the retailer to open the online outlet channel due to the market opportunity it presents for the retailer.

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