"Bricks & Clicks": The Impact of Product Returns on the Strategies of Multi-Channel Retailers

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Abstract

The Internet has increased the flexibility of retailers allowing them to operate an online arm in addition to their physical stores. While the online channel offers retailers potential advantages in selling to customer segments that value the conveniences of online shopping, it also raises new challenges. These include the higher likelihood of costly product returns when customers’ ability to ‘touch and feel’ the product is important in determining fit. We study competing retailers operating dual channels (“Bricks and Clicks”) and examine how pricing strategies and the level of physical store assistance change as a result of the additional Internet outlet. On the supply-side, firms endogenously determine prices and how much to invest in store characteristics that assist customers in finding matching products (e.g., greater shelf display capacity, more qualified staff, floor samples). On the demand-side, we capture two relevant sources of customer heterogeneity: (i) retailer preference, and (ii) shopping trip costs. A central result we obtain is that when differentiation among retailers is not too high, having an online channel actually increases (costly) investment in store assistance levels while prices are set higher. We also examine how firms’ range of product categories can vary between the two channels. Our main finding here is that even though it is costless to offer products online, retailers will sell only a limited assortment over the Internet. In particular, only “safe” products with a low chance of being returned will be sold online, while retailers’ full range of products will be sold in physical stores.

(Channels of Distribution, Retailing, Internet Marketing, Pricing, Reverse Logistics, Product Returns)
“By the start of 2001, bricks-and-clicks had emerged as the winning business model of online retailing” (Prior 2002).

1 Introduction

As consumer access to the Internet continues to grow, with sales online in 2005 reaching $176 billion (NRF 2006), it is becoming increasingly apparent to retailers that they cannot ignore the possibility of selling products online.\textsuperscript{1} While the stock market crash of 2000 wiped out many pure-play Internet retailers that were unable to generate sufficient traffic to their sites, most established retailers with strong traditional bricks and mortar presence have since ventured into the online world. These retailers can showcase their products online at negligible costs, and leverage the familiarity with their established brand to appeal to customers who value the convenience of online shopping.

The advantages offered by the online outlet do not come free, however. The problem, well known to direct marketers, is the hidden cost associated with product returns. The problem is particularly acute in categories where consumers need to “touch and feel” the product in order to determine how well it fits their tastes and needs. For example, it is very difficult for a consumer seeking a new sofa to ascertain how comfortable a particular model is without actually sitting on it. It is further difficult to judge the aesthetic appeal of the sofa’s design, texture and color without physically seeing it as opposed to merely viewing a digital image on a computer screen. The same is true for clothes, jewelry, sporting goods, artwork, etc. In such categories, relevant attributes for consumer decision-making are “non-digital” and difficult to communicate electronically. By contrast, retailers do have control over the relevance of the shopping environment in stores. By placing samples of more models on the floor, or making sure that a full assortment of products is properly shelved and displayed, the merchant is more likely to ensure that the customer finds the right product. Hiring highly qualified salespeople or training existing ones to assist customers as they inspect and

\textsuperscript{1}A recent Jupiter report states that the “online population” reached 69\% of the total U.S. population in 2005 and is expected to reach 75\% by 2011 (Jupiter Research, 2006). Furthermore, it is estimated that 78\% of Internet users have bought something online. In a 2001 report on Global Online Retailing, Ernst & Young finds that almost two-thirds of their 7,000-plus survey participants worldwide (74\% in the U.S.) have purchased something online in the 12-months period preceding the survey. The report concludes that “online retailing is now a business requirement”.

try out the product, further reduce the likelihood of a mismatch. Thus, while the ability to reduce the chances of product returns online are quite limited for products with non-digital attributes, the retailer has this ability in its physical store through investment in appropriate sales assistance activities.

When product returns do occur, handling the returned merchandise can impose substantial costs on retailers. Beyond the need to collect the unwanted product from the customer, the retailer must either refurbish and restock the product if it can be resold, sell the product to a third party for a salvage value, or, in extreme cases, dispose of the product altogether. It is estimated, for example, that selling to a third party liquidator only recoups 10-20% of the returned product’s original value (Stock et al. 2006). The substantial transaction and logistic challenges of product returns, that have become particularly acute with the advent of the Internet, have resulted in the birth of a new industry dedicated to these reverse logistics activities. The recent rise and success of companies like Newgistics and The Return Exchange, which specialize in merchandise returns management, attests to this trend. As a percent of sales, the figures are staggering. Data by Gentry (1999) show that while overall customer returns are estimated at 6% of retail sales, they are significantly higher for catalog and e-commerce retailers, ranging from 18-35% depending on the category. In all, it is estimated that managing product returns costs U.S. companies over $100 Billion annually (Enright 2003).

But the supply-side cost of returns is only one aspect of the problem. Returning mismatched merchandise can be a costly process for consumers as well. First, there is the opportunity cost of time associated with the return process itself (going back to the store or mailing an item back). Second, there is the disutility associated with not having a matching product for the duration of time from the initial purchase till the return. Third, not all return policies are lenient. In many cases a restocking fee is imposed on the consumer amounting to 15% of the purchase, waiting periods are required before issuing cash refunds and, increasingly, retailers only offer store credit (Wall Street Journal 2005). The higher probability of returning an item purchased on the web makes these costs all the more pronounced for the online channel. A consumer survey by Jupiter Research (2003) found that 46% of respondents with online access preferred to shop in physical stores because otherwise they “couldn’t see, touch, sample or try on the product”. Furthermore, 17% specifically indicated hassle of returning products as a reason to not shop online. In sum, while the online
channel may allow targeting customers that value the ability to economize on shopping trip expenses, the fact that higher returns often accompany online shopping has implications for buying behavior and, consequently, retailer actions.

The opening of an online shopping channel, the “Click” arm, may prompt competing retailers to re-evaluate several of their key strategic practices. First, retailers may seek to modify their pricing given that a certain portion of consumers will find it beneficial to buy online and fewer consumers frequent stores. But beyond adjusting prices, the new channel may cause retailers to re-think how they sell and what they sell on the two channels. In particular, if some sales shift to the online outlet and less shoppers frequent stores, one might expect retailers to adjust in-store assistance levels. In addition, retailers need to understand whether all product categories they carry will sell on both channels. In particular, given that showcasing product is virtually free over the Internet, one might expect more types of products to be sold online than offline. From a managerial standpoint, setting proper marketing mix variables when operating multiple channels, particularly the Internet and bricks and mortar stores, is seen as one of the most pressing challenges facing retailers today (Nunes and Cespedes 2003).

Our goal in this paper is to explore how adopting the multi-channel ("Bricks & Clicks") format affects the strategic behavior of competing retailers, in categories where physical inspection reduces the chances of product returns. Specifically, we ask the following questions:

- How does operating multiple channels affect pricing strategy? Are prices set to increase or decrease as a result of operating an online channel in addition to physical stores?
- How does the introduction of an online channel affect the level of in-store shopping assistance that retailers provide? Under what conditions would retailers consider offering more assistance even though a portion of consumers now shops online?
- How does the range of products sold online differ from that sold in physical stores? Should we expect more categories of products to be offered online than offline?

To address these questions, we construct a model with two competing retailers each operating dual channels. Consumers can purchase products in stores, where they are able to physically inspect products, or they can purchase online without such benefit. Firms set prices and can reduce the offline product return probability by investing in costly store
assistance (SA). We allow consumers to be heterogenous along two dimensions: (i) their preferences for the products offered by each retailer and (ii) their cost of making a shopping trip to the physical store. Our analysis proceeds in two stages. We begin by analyzing the case of a product with a base probability of return and focus on comparing the strategies of single channel retailers to those of dual channel retailers. We then extend the model to allow two different product categories, and examine whether there can be an asymmetry in the type of products sold in each of the retail channels.

In our analysis, it will become apparent that, in effect, product returns act to increase the marginal cost of doing business. Retailers may pass on this higher marginal cost by increasing price or opt to reduce the volume of returns by making the physical store environment more conducive to consumer inspection (increasing SA level). We show that which of these two marketing levers retailers choose to pull critically depends on the degree of differentiation between the retailers. In particular, the lower the degree of differentiation the greater the store assistance level retailers provide. Interestingly, when differentiation is low enough we are able to show that the level of store assistance may exceed that in the Bricks-only case—even though a portion of consumers now shops online, i.e., less consumers shop in stores. As a result, retailers earn lower profits compared to when only physical stores exist. By contrast, when differentiation is high, retailers opt to increase prices drastically and reduce costly store assistance, resulting in greater profits relative to the Bricks-only case.

We then allow retailers to carry two distinct product categories that can differ in their base return probability— a situation faced by many general merchandise retailers who carry products ranging from consumer electronics to apparel. Here, we get the intriguing result that even though it is costless to offer products online, retailers may end up selling only a limited set of products over the Internet. In particular, we show that retailers may sell only the “safer” product online (i.e., the one with a lower returns probability), while selling their full range of products in the physical store. This result stems from the fact that, due to competition, a retailer cannot pass on the entire cost of returns from the “riskier” product onto consumers by charging a high price (because the rival would undercut its price). Therefore, retailers prefer to create conditions that will induce purchase of the riskier product only in the store channel, where they can manage the returns likelihood through store assistance.

Collectively, our results suggest that opening an additional channel— namely the Inter-
net outlet can have important strategic implications for how retailers set marketing mix variables. Moreover, we show that one of the key consumer issues with the online channel—the inability to physically inspect products to reduce the likelihood of a return—can affect retailer decisions in the store and lead to differences in the type of products sold across the channels.

The rest of the paper is organized as follows. The next section summarizes the relevant literature. This is followed by the model description in Section 3. We begin by analyzing the benchmark case with no Internet channel (Bricks-only). Subsequently, we model competition between multi-channel retailers under two scenarios: in the first, retailers sell a single product category, and in the second, they sell two product categories that can differ in the base return probability. In Section 3.6, we analyze an extension in which firms can charge separate prices across the retail channels. We end with a discussion of the findings and model limitations in Section 4. All proofs and technical details appear in the Appendix.

2 Related literature

Our work is primarily related to two streams of research. The first examines the implications of the Internet for consumer and retailer behavior and the second studies various aspects associated with customer product returns. We discuss each of these streams in turn. Early work on the Internet as a channel of distribution was mostly concerned with pure-play e-tailers (e.g., Bakos 1997) and competition between Bricks-only retailers and a direct retailer (Balasubramanian 1998). Subsequent papers have begun studying the implications of operating dual channels. In Lal and Sarvary (1999), the introduction of an online channel is shown to affect consumers’ search behavior and, under certain conditions, to result in higher equilibrium prices. Their model assumes that consumers are exogenously familiar with the fit of products from only one of the retailers and that firms are not able to control the ease/difficulty of consumer search. Zettelmeyer (2000) examines situations where competing retailers can provide information to consumers both online and offline to help them determine their utility for the products offered. Providing information is costless online, but there is a cost offline. Having dual channels is shown to increase the amount of information provided, with both firms facilitating search online, but only if a limited fraction of consumers have access to the Internet. Our work differs from the above papers in that we
focus on the implications of a product mismatch and return from the consumers’ and firms’ perspective. We assume that all consumers have access to the Internet and that, given the nature of products under consideration, the uncertainty associated with determining fit can only be reduced in physical stores. We also examine the actions firms can take to reduce product returns through investment in store assistance.\footnote{Biyalogorsky and Naik (2003) present an empirical methodology to measure how online activities may affect offline sales.}

The second stream of research examines issues specifically related to product returns, but in a single channel context. Davis et al. (1995) examine a retailer’s incentives to offer a money back guarantee for mismatched products. They show that as long as the retailer’s salvage value from returned merchandise is high enough, it is profitable to offer money back guarantees. Hess, Chu and Gerstner (1996) extend the analysis to show that a retailer can use a non-refundable charge to limit opportunistic returns behavior by customers who purchase the product to derive value for a limited period and then return it for a refund. More recently, Shulman et al. (2006) have studied optimal returns policies by considering a retailer’s incentives to charge higher restocking fees and to provide full information about fit to consumers. They are able to show that, under certain conditions, providing full information may actually hurt retailer profits because consumer uncertainty can allow charging a higher price. Moorthy and Srinivasan (1995) examine the role of money back guarantees in a competitive context as a signal of product quality. They show that the high quality seller charges a higher price and offers a money back guarantee. In our model, such signaling issues do not arise. Though this literature provides valuable insights into our understanding of returns policies, it does not address the challenges faced by competing retailers that operate multiple channels. In particular, it ignores the trade-off between selling at a high price (due to the existence of a customer segment that values the convenience of online shopping) and mitigating the returns problem through costly investment in store assistance. As we will show, the interplay between returns rates and dual channels has an impact on retailer strategies both in the physical stores as well as on the Internet.

In sum, the central contribution of our work is in marrying the above two streams of literature by studying the implications of consumer product returns in a multi-channel context—a problem faced by many retailers today. We incorporate key characteristics of buyer behavior in deciding through which channel to shop, and ask how the Internet, as a second
viable channel, might impact strategic retailer behavior in terms of the prices charged and the investment in the physical store environment.

3 The Model

3.1 Retailers

There are two vertically integrated retailers indexed \(i\) \((i = 1, 2)\) offering a differentiated product at zero marginal cost of production. The product comes in a number of sizes, designs or models such that consumers need to determine which variant fits their taste. Product quality is assumed to be identical across retailers.\(^3\) The retailers can sell the product in their stores, denoted \(S\), and on their Internet site, denoted \(N\). The probability that any specific product purchased without physical inspection meets the tastes of a consumer is \(\lambda_N\), \(0 \leq \lambda_N < 1\). This represents a baseline ex-ante probability of match, and is assumed to be equal for the products of the two retailers. Hence, with probability \((1 - \lambda_N)\) a consumer who purchases the product on the Internet, where physical inspection is impossible, will return the product due to a mismatch. In that case, the retailer will have to incur a cost of \(g\) to handle the returned merchandise (refurbish/recondition the product or sell for a salvage value in a secondary market). Also write \(r \equiv (1 - \lambda_N)g\) for the baseline expected cost of handling a return for the retailer.

In stores, consumers can physically inspect products. Furthermore, firms can invest in conditions and factors that reduce the likelihood of a mismatch and hence a return. As discussed earlier, this might include having greater store capacity to properly showcase the full set of models and sizes of the product, the hiring of more knowledgeable salespeople at higher salaries, the installation of special equipment (such as sound rooms) to enhance the trial experience, and the foregoing of sample products placed “on the showroom floor”.

Depending on the level of store assistance (SA), denoted \(\lambda_S\), \(0 \leq \lambda_S \leq 1\), the likelihood that a product purchased at the store will be returned is lower compared to when it is purchased online and becomes \((1 - \lambda_S)(1 - \lambda_N)\). The expected cost of handling a return in the store is thus \((1 - \lambda_S)r\).\(^4\) Providing store assistance level \(\lambda_S\) entails an upfront investment that comes

\(^3\)That is, the two retailers offer products that are equally reliable or durable and there are no vertical quality dimensions along which they differ.

\(^4\)We are thus assuming that the cost itself of processing and handling the return \((g)\) is similar on the
at a cost of \( h(\lambda_S)^2/2 \), i.e., lowering the product return rate entails a marginally increasing (convex) expenditure.

Retailers first decide on SA levels \((\lambda_S)\) and then choose prices \((p_i)\). Decisions in each stage are simultaneous. We assume that prices are the same on the Internet and in the store for each retailer. This is realistic if arbitrage opportunities across channels are easily exploited or if retailers worry about reputation backlash when consumers discover markedly different pricing schemes across outlets. This is also in line with industry practice, as nearly 80% of retailers have consistent pricing across channels (NRF 2006). In an extension (Section 3.6) we relax this assumption to look at the case of separate pricing across the two channels.

### 3.2 Consumers

Consumers have unit demand for the product, with reservation price \( v \), and are heterogeneous along two dimensions. First, with respect to their preferences for the two retailers, we assume that consumers are uniformly distributed along a segment of unit length connecting the retailers. Consumers’ preference for the products of each retailer, measured by \( x \) and \( 1 - x \) for retailer 1 and 2, respectively, reflect the utility they give up when buying a product from that retailer. Since this is a measure of preference for the retailer’s brand (or unique styles), it is irrespective of whether the product has been purchased in a store or on the Internet.

The degree of product differentiation between retailers is \( t \). We assume that the reservation price \((v)\) is large so that the entire market is covered.

Internet and in stores. We make this assumption for convenience and because we wish to focus on other central aspects of the problem at hand (namely, the operation of dual channels, pricing, SA levels, and retailer differentiation). The nature of our findings is not qualitatively altered by allowing separate return costs. But note that because the main cost of handling returned merchandise is associated with refurbishing/reconditioning the returned product or selling it in a secondary market, similar costs arise regardless of where the item was purchased.

Liu, Gupta and Zhang (2006) provide strong support for why the assumption of price consistency across channels is reasonable (pg. 1800). They analyze the case of an incumbent bricks and mortar retailer debating whether to open an online arm. They show that when prices are required to be consistent, refraining from opening such an arm can deter pure e-tailer entry. In our model, both retailers operate dual channels and we focus on the role of returns and store assistance in addition to price.

For example, a consumer might prefer products offered by the Gap over those offered by Abercombie and Fitch. The importance of retailer brand on the Internet as a driver of consumer purchase has been demonstrated empirically (for example, Brynjolfsson and Smith 2000; and Smith and Brynjolfsson 2001).
Consumers are also heterogeneous with respect to their cost of shopping in stores. Specifically, for a proportion $\mu$ of the consumers this cost is $k_L = 0$, while the remaining $(1 - \mu)$ consumers incur a cost $k_H = k > 0$. These costs reflect the need to travel to the store, spend time locating desired items, standing in lines to purchase, etc.\(^7\) The cost of shopping on the Internet is 0 for both consumer types and we assume that all consumers have access to the Internet. If consumers are indifferent between shopping on-line and in the store, we assume they choose the Internet.

In the event of a product mismatch, consumers incur costs associated with returning merchandise, we denote these costs by $m$. Consistent with previous notation, the consumer’s baseline expected return cost is then $c \equiv (1 - \lambda_N)m$. A consumer visiting a store benefits from retailer efforts $\lambda_{S_i}$ that help determine fit. Hence, the consumer’s expected return cost from purchasing at store $i$ is $(1 - \lambda_{S_i})c$. We assume that consumers return the product only once. After any such actual usage and return instance they can reliably figure out which product variant fits them. This is also reasonable if we assume that after each purchase and “at home” mismatch trial the likelihood of an additional mismatch is significantly lowered. In this interpretation, $r$ and $c$ are associated with the cumulative and discounted cost of all future returns till a match is secured.\(^8\) Our formulation is also equivalent to assuming that retailers only provide credit for additional purchase when merchandise is returned.

Prices and SA levels are known to consumers. When purchasing at the physical store of retailer $i \in (1, 2)$, a consumer located at $x$ with shopping trip cost $k_j$ gets expected utility of

$$U_{S_i}(x, k_j) = v - p_1 - tx - (1 - \lambda_{S_i})c - k_j, \quad U_{S_2}(x, k_j) = v - p_2 - t(1 - x) - (1 - \lambda_{S_2})c - k_j. \quad (1)$$

If the consumer buys on the Internet, the expected utility from either retailer is

$$U_{N_1}(x, k_j) = v - p_1 - tx - c, \quad U_{N_2}(x, k_j) = v - p_2 - t(1 - x) - c. \quad (2)$$

\(^7\)A different interpretation is that the $k_L$ type consumers derive more utility from the shopping experience in stores than $k_H$ types. This segmentation can be occasion specific, whereby in some shopping situations the individual is more time constrained.

\(^8\)This is consistent with our model formulation in the following way. Denote with $V_{C_i}$ a consumer’s net benefit from purchasing a matching product from retailer $i$ at channel $C$. Then, for purchases on the Internet: with probability $\lambda_N$ the product is a match in the first purchase while with probability $(1 - \lambda_N)$ it is a match only in a subsequent purchase. Ignoring discounting, expected utility is: $U_{N_1} = \lambda_NV_{N_1} + (1 - \lambda_N)(V_{N_1} - m) = V_{N_1} - c$. Analogously for stores: the probability of first purchase match is $(\lambda_N + \lambda_{S_i} - \lambda_N\lambda_{S_i})$ and mismatch $(1 - \lambda_N)(1 - \lambda_{S_i})$. Hence, expected utility becomes: $U_{S_i} = (\lambda_N + \lambda_{S_i} - \lambda_N\lambda_{S_i})V_{S_i} + (1 - \lambda_N)(1 - \lambda_{S_i})(V_{S_i} - m) = V_{S_i} - (1 - \lambda_{S_i})c$. 

9
Comparing the expected utility of the different options, each consumer decides from which retailer and in what channel to purchase. Clearly, with consistent prices across the two distribution outlets, type $k_L$ consumers always visit the stores, as it is costless for them to do so and it reduces the likelihood of returns (whenever $\lambda_{S_i} > 0$). Type $k_H$ consumers, however, may prefer to buy on the Internet— even if it means higher chances of returns— because of their even higher shopping trip costs to visit the stores. Consumers’ purchase decisions generate demand for each retailer per-channel, $D_{S_i}$ and $D_{N_i}$. Denote the vector of prices: $\vec{p} = (p_1, p_2)$ and of SA levels $\vec{\lambda} = (\lambda_{S_1}, \lambda_{S_2})$. Total expected profits for retailer $i$ are then given by

$$\pi_i = (p_i - (1 - \lambda_{S_i})r)D_{S_i}(\vec{p}, \vec{\lambda}) + (p_i - r)D_{N_i}(\vec{p}, \vec{\lambda}) - 1/2h(\lambda_{S_i})^2. \quad (3)$$

We assume that the SA cost factor, $h$, is large enough to ensure an interior solution for $\lambda_{S_i}$ (see (A9) in the Appendix).

### 3.3 Benchmark: Bricks-only case

Let us first explore the benchmark case when the Internet does not constitute an additional channel for retailers to sell through. The following proposition summarizes the outcome of this “Bricks-only” case. Note that throughout the paper we only consider equilibria in pure strategies.

**Proposition 1** When retailers distribute products through their physical stores only, then there is a unique and symmetric sub-game perfect equilibrium in which

$$\hat{\lambda}_{S_1} = \hat{\lambda}_{S_2} \equiv \hat{\lambda}_B = \frac{c + r}{3h},$$
$$\hat{p}_1 = \hat{p}_2 \equiv \hat{p}_B = t + r(1 - \hat{\lambda}_B),$$
$$\hat{\pi}_1 = \hat{\pi}_2 \equiv \hat{\pi}_B = \frac{1}{2}(t - h\hat{\lambda}_B^2). \quad (4)$$

We highlight several key features of this solution. When firms compete with Bricks stores only, they desire to increase SA levels ($\hat{\lambda}_{S_i}$) the greater the baseline cost of returns to the consumer or the firm ($c, r$). The impact of the latter is intuitive: when $r$ increases firms wish to directly reduce expected supply-side costs by lowering the probability of returns taking place. Increasing SA levels when $c$ increases stems from the need to mitigate the
decrease in willingness to pay of consumers (demand-side costs). It is worthwhile noting that in this Bricks-only scenario, SA levels in equilibrium do not depend on the degree of differentiation between retailers ($t$). As one might expect, however, prices do increase in the level of differentiation, because higher $t$ means that demand is less price sensitive. Price is also a function of the expected cost to the retailer of a product return, through the term $r - r\hat{\lambda}_B$. This is because from the retailer’s perspective, the possibility that each product sold may be returned is like a “variable cost” of doing business (see (3)) that is at least partly passed on to the consumer. Thus, whenever firms increase SA levels and reduce the probability of returns, this has a negative effect on prices (much like the effect of a drop in marginal cost in the standard Hotelling model). This leads firms to lower prices as $c$ increases (through the dependence of $\hat{\lambda}_B$ on $c$ as explained above). Note though that the impact of an increase in $r$ on prices has both a direct positive effect (because of the desire to transfer the return costs onto consumers) and an indirect negative effect (through $\hat{\lambda}_B$). Initially as $r$ increases, firms will prefer to pass on some of the expense of handling returns onto consumers through higher prices. But as the expected cost of handling a return ($r$) goes up further, firms will be induced to manage the high returns costs by increasing store assistance levels. At some point, the indirect effect resulting from increasing SA level dominates, and firms will begin decreasing prices as $r$ rises; leading to an inverted-U pattern for prices as a function of $r$. Lastly, note that as the SA cost factor ($h$) increases firms sharply decrease SA levels in equilibrium, which results in higher prices and profitability. A summary of these comparative statics is presented in the second column of Table 1.

3.4 Bricks & Clicks

We now examine the case of retailers that operate physical stores as well as online outlets. In characterizing the solution, we need to distinguish between two cases depending on whether the $k_H$ type consumers shop online in equilibrium. Type $k_H$ consumers prefer to shop online from retailer $i$ if and only if the cost of making the trip to the retailer’s store is greater than the reduction in expected returns costs they would achieve due to store assistance (i.e., $c\lambda_{S_i} \leq k$). This implies that the choice of store assistance levels not only affects how intensely the two retailers compete for the $k_L$ type consumers who always shop in stores, but also determines where $k_H$ type consumers will shop. In the following proposition, we handle
the case of high enough shopping trip costs that induce sales in both outlets in equilibrium.

**Proposition 2** There exists a $k(c,r,h,t,\mu) < c$, such that if $k \leq k$, there is a unique symmetric sub-game perfect equilibrium where $k_L$ type consumers always shop in physical stores while $k_H$ type consumers shop on the Internet. In equilibrium

\[
\hat{\lambda}_{S_1} = \hat{\lambda}_{S_2} \equiv \hat{\lambda}_{BC} = \frac{2\mu t(c + r)}{6ht - 3rc\mu(1 - \mu)},
\]

\[
\hat{p}_1 = \hat{p}_2 \equiv \hat{p}_{BC} = t + r(1 - \mu\hat{\lambda}_{BC}),
\]

\[
\hat{\pi}_1 = \hat{\pi}_2 \equiv \hat{\pi}_{BC} = \frac{1}{2}(t - h\hat{\lambda}_{BC}^2).
\]

This equilibrium solution differs from the Bricks-only case in several important ways. As is evident from (5), SA levels, $\hat{\lambda}_{BC}$, now directly depend on the level of retailer differentiation ($t$) and on the fraction of consumers with low shopping trip costs ($\mu$). In particular, the higher $t$ the lower SA levels are. This dependence arises because the decision to enhance the in-store environment only reduces the chances of returns for a fraction $\mu$ of shoppers that visit the store, while at the same time resulting in a reduction in price for all shoppers; including the $k_H$ type consumers who don’t benefit from SA. This tradeoff was absent in the Bricks-only scenario as all consumers shopped in stores. Note also that if retailers face consumers with shopping trip costs in the range $k \in (\bar{k},c]$, they will forgo the option to set a high SA level to attract all customers to the store. Instead, retailers will segment consumers based on shopping trip costs by choosing lower SA levels and charging higher prices.

We establish that the following relationships hold

**Corollary 1** Comparing the Bricks-only and Bricks & Clicks equilibria of Propositions 1 and 2 respectively, we have that $\hat{p}_{BC} > \hat{p}_{B}$, whereas $\hat{\lambda}_{BC} > \hat{\lambda}_{B}$ and $\hat{\pi}_{BC} < \hat{\pi}_{B}$ if and only if $t < \frac{\mu cr}{2h}$.

As the above corollary shows, competing on both online and offline fronts can actually result in greater SA levels. This intriguing result is driven by the general feature of our model, whereby firms have two marketing levers to pull in order to remain competitive. They can either adjust price or SA level (or both). In the Bricks & Clicks scenario, the negative impact of increasing SA level on prices is less pronounced than in the Bricks-only case because it only affects competition over the fraction $\mu$ of customers shopping in the stores. Hence, firms
may have an incentive to offer higher levels of SA. This critically depends on the degree of differentiation $t$ being relatively low; because otherwise, when the degree of differentiation is high, price competition is less intense and firms can transfer more of the returns costs onto consumers by charging high prices instead of providing higher SA levels. However, since SA is costly to the retailer, increasing its level results in lower profits overall. Notice also that there exists a region where both prices and SA levels are higher when firms operate dual channels.

The comparative static results for $\hat{\lambda}_{BC}$ and $\hat{p}_{BC}$ with respect to $t$ are in line with the above intuitions (see third column of Table 1). With respect to the fraction of consumers with low shopping trip costs ($\mu$) we get the following result

**Corollary 2** There exists a $\mu$, such that as the proportion of consumers with low shopping trip cost increases: $\hat{\lambda}_{BC}$ will increase in the range $\mu \in [0, \mu]$ and decrease in the range $\mu \in [\mu, 1]$, while $\hat{p}_{BC}$ will decrease in the range $\mu < 2\mu^2$ and increase in the range $\mu > 2\mu^2$.

Thus, Corollary 2 reveals that SA levels and prices will follow a non-monotonic pattern as the fraction of consumers with different shopping trip costs changes. The intuition is as follows. Initially as $\mu$ increases, having more consumers that shop in physical stores drives retailers to offer greater SA levels to reduce these consumers’ chance of return. As we explained before, this puts an indirect negative pressure on prices because part of the expected variable cost of handling returns is mitigated. Given that prices are still relatively high at this point, the sacrifice in price is palatable. However, when $\mu$ increases further and an increasing number of consumers shop in the store, the indirect negative effect on prices starts dominating and induces the retailers to revert back to the SA levels they would set when there was only a Bricks outlet – and as they reduce SA levels prices increase.

Up to now we have focused on characterizing the equilibrium in which retailers could segment consumers along shopping trip costs and achieve positive sales in both channels. This was possible when the shopping trip cost for the $k_H$ type consumers was high enough.

Another way to think about this result is that the retailers would be better off if they did not have to offer SA. But given competition, they end up both offering it in equilibrium (similar to a prisoner’s dilemma situation). When the $k_H$ types shop online and price competition is not too intense, the Internet channel allows the retailers to scale back their SA levels (relative to the bricks-only case) and raise prices; which leads to higher profits.
Now let us examine the case when the shopping trip cost is relatively low \((k < \bar{k})\), so that even the \(k_H\) type consumers may want to shop in stores.

**Proposition 3** There exists a \(k\) \((k \leq \bar{k})\) such that

- If \(0 < k \leq k\), there is a unique symmetric sub-game perfect equilibrium where every consumer shops in physical stores and store assistance levels and prices are equal to the bricks only case, that is, \(\hat{\lambda}_{S_1} = \hat{\lambda}_{S_2} \equiv \hat{\lambda}_B\) and \(\hat{p}_{S_1} = \hat{p}_{S_2} \equiv \hat{p}_B\).

- If \(k < k \leq \bar{k}\), there is no symmetric sub-game perfect equilibrium.

What Proposition 3 tells us, is that the SA level that retailers set when there is only a physical store outlet \((\hat{\lambda}_B)\) is sufficient to entice \(k_H\) type consumers to go to physical stores when the shopping trip cost they have to incur is low enough. In this case, even though the online outlet exists and features the product, in effect, all consumers purchase at the physical stores. Moreover, in our model we did not assume any fixed cost associated with selling products online, such as setting a dedicated distribution center or setting up a separate division to manage online sales. But if there were such a fixed cost, then for low enough values of \(k\), the retailers would opt to not offer the product for sale online, given that in equilibrium no actual sales take place.\(^{10}\)

Another way to think about Propositions 2 and 3 is that only when there exists a segment of consumers that sufficiently value the convenience of online shopping \((k > \bar{k})\), will retailers end up serving them through their Internet channel in equilibrium. Furthermore, only if the retailers are highly differentiated, per Corollary 1, will the additional channel lead them to offer lower SA levels in stores and charge much higher prices— which results in greater profits.

### 3.5 Bricks & Clicks Retailers Selling Multiple Products

In the analysis up to this point, we only considered one product type that each retailer carried. This allowed us to examine the primary forces at work with respect to setting SA levels and prices. However, in reality, retailers usually carry a number of different product categories or sub-categories. For example, Best Buy carries a number of different consumer

\(^{10}\)Of course, the online website could be relevant as a marketing tool to allow consumers to browse and be informed about the firm’s products; but the firm would not register sales over the online channel.
electronic goods—ranging from digital devices (cameras, computers, etc.) to home appliances (refrigerators, laundry machines, etc.). The Gap offers a number of apparel categories (jeans, activewear, swimwear, etc.) as well as a number of accessory categories (bags, shoes, belts, etc.). Sears, a general merchandise retailer, carries all of the above categories. Given that each of the categories or product lines offered can be associated with a different base probability of return (Rogers and Tibben-Lembke, 1999), it is important to understand how retailers make strategic decisions when offering multiple categories. We specifically wish to answer the following questions. Will retailers sell more product categories on their Internet site or in their physical store? If a certain type of product has a lower baseline probability of fit (i.e., higher ex-ante return probability), under what conditions will it be sold on both outlets vis-à-vis other conditions where it is sold through only one channel?

In what follows, we generalize the basic model so that retailers carry two products. Let the two distinct products be denoted \( \alpha \) and \( \beta \), each with a different baseline ex-ante probability of fit. Without loss of generality, we can assume that \( \lambda_{N_{\alpha}} < \lambda_{N_{\beta}} \). That is, the baseline expected return costs for a consumer are \( c_{\alpha} \equiv (1 - \lambda_{N_{\alpha}})m \) and \( c_{\beta} \equiv (1 - \lambda_{N_{\beta}})m \) for the two products respectively, with \( c_{\alpha} > c_{\beta} \).\(^{11}\) Therefore, ex-ante, product \( \beta \) can be regarded as the “safer” of the two products. Retailers choose the SA level to provide for each of the two products \( (\lambda_{S_{i\alpha}}, \lambda_{S_{i\beta}}) \) and the price for each \( (p_{i\alpha}, p_{i\beta}) \). It is straightforward that each retailer can price the two products differently, but SA levels can also differ—for example, a retailer could devote more salespeople to certain products, set aside more demo units or special equipment to try certain goods, or even allocate more prime store space for some of the categories it carries.

We assume that on a given shopping occasion each consumer is either looking for product \( \alpha \) or \( \beta \). Specifically, a proportion \( \nu \) of the consumers have a unit demand for product \( \alpha \), whereas the remaining \( (1 - \nu) \) consumers have a unit demand for product \( \beta \). We assume for simplicity that whether a consumer is looking for product \( \alpha \) or \( \beta \) is independent of that consumer’s shopping trip cost. All other assumptions are identical to those of the basic model.

Consistent with previous notation and findings, let \( \hat{\lambda}_B(c) = \frac{c+r}{3h} \) denote the equilibrium SA level in the bricks-only case as a function of \( c \), and let \( \hat{\lambda}_{BC}(c) = \frac{2\mu(c+r)}{6ht-3r\mu(1-\mu)} \) denote the equilibrium SA level in the bricks and clicks case for \( k \geq \bar{k} \). Note that by setting prices and

\(^{11}\)We assume that the lower bound for \( h \) in (A9) holds for both \( c_{\alpha} \) and \( c_{\beta} \).
SA levels, firms affect consumers’ shopping behavior. In particular, whether the $k_H$ type consumers purchase a given product online or in the store. The case where no consumer purchases a product over the Internet is equivalent to not offering that product for sale to begin with through the online channel. The following proposition characterizes the equilibria of the multiple product case.

**Proposition 4** There exist $k_1, k_2, k_3, k_4$ such that $0 < k_1 < k_2 \leq k_4$ and $0 < k_1 < k_3 < k_4$ and the following hold

- If $k > k_4$ then there is a unique symmetric sub-game perfect equilibrium where $k_L$ type consumers always shop in physical stores while $k_H$ type consumers shop on the Internet. SA levels and prices are: $\hat{\lambda}_{S_{1a}} = \hat{\lambda}_{S_{2a}} \equiv \hat{\lambda}_{BC}(c_\alpha)$, $\hat{\lambda}_{S_{1b}} = \hat{\lambda}_{S_{2b}} \equiv \hat{\lambda}_{BC}(c_\beta)$ and $\hat{p}_{1a} = \hat{p}_{2a} \equiv \hat{p}_{BC}(c_\alpha)$, $\hat{p}_{1b} = \hat{p}_{2b} \equiv \hat{p}_{BC}(c_\beta)$.

- If $k_3 \geq k > k_2$ then there is a unique symmetric sub-game perfect equilibrium where every consumer of product $\alpha$ shops in physical stores and consumers of product $\beta$ shop on the Internet if and only if their type is $k_H$. SA levels and prices are: $\hat{\lambda}_{S_{1a}} = \hat{\lambda}_{S_{2a}} \equiv \hat{\lambda}_{B}(c_\alpha)$, $\hat{\lambda}_{S_{1b}} = \hat{\lambda}_{S_{2b}} \equiv \hat{\lambda}_{BC}(c_\beta)$ and $\hat{p}_{1a} = \hat{p}_{2a} \equiv \hat{p}_{B}(c_\alpha)$, $\hat{p}_{1b} = \hat{p}_{2b} \equiv \hat{p}_{BC}(c_\beta)$.

- If $k_1 \geq k$ there is a unique symmetric sub-game perfect equilibrium where every consumer shops in physical stores. SA levels and prices are equal to the bricks only case for both products, that is, $\hat{\lambda}_{S_{1a}} = \hat{\lambda}_{S_{2a}} \equiv \hat{\lambda}_{B}(c_\alpha)$, $\hat{\lambda}_{S_{1b}} = \hat{\lambda}_{S_{2b}} \equiv \hat{\lambda}_{B}(c_\beta)$ and $\hat{p}_{1a} = \hat{p}_{2a} \equiv \hat{p}_{B}(c_\alpha)$, $\hat{p}_{1b} = \hat{p}_{2b} \equiv \hat{p}_{B}(c_\beta)$.

- Otherwise, there is no pure-strategy sub-game perfect equilibrium.

Figure 1 depicts the different regions of the equilibrium in terms of where each product is sold. When the segment that values the convenience of online shopping has to incur a very high shopping trip cost, $k > k_4$, retailers set prices and SA levels to induce purchases of both products through the Internet (to the $k_H$ types) and the store (to the $k_L$ types). When at the other extreme the shopping trip cost is very low, $k_1 \geq k$, retailers end up serving all consumers in physical stores only. In the mid region, when the shopping trip cost satisfies $k_3 \geq k > k_2$, we get the intriguing result whereby the retailers set an SA level for the riskier product ($\alpha$) such that all consumers shop for it only in the store, whereas the safer product ($\beta$) is purchased in both channels. Based on our findings in Propositions
2 and 3, the intuition for this outcome is as follows. Because of the difference in base return probability for the two products, the cutoff value of $k$ that makes $k_H$ type consumers indifferent between shopping online and offline, i.e., $U_S(k) = U_N(k)$ (see (1)-(2)), is different for the two products. Moreover, given that the retailers want to manage the supply side cost associated with returns, they tend to set higher SA levels for products that have greater expected returns costs (see discussion after Proposition 1); this further entices consumers to buy such products in the store. Combining these pieces together, we get that when the difference in return probabilities between the two products is sufficiently high, retailers will end up selling the safer of the two on both channels and sell the riskier one only in stores.

The following corollary identifies a necessary condition under which the equilibrium with limited online product assortment exists.

**Corollary 3** If

$$c_\beta < \frac{c_\alpha (c_\alpha + r)}{3h}$$

then $k_2 < k_3$.

Hence, if the expected consumer return cost from the safer product is sufficiently lower than that of the riskier product, we will always be able to find a region of shopping trip costs such that firms will sell one product only in stores while the other sells online and offline. For retailers that carry a variety of different products, there will likely be some categories for which the condition in Corollary 3 is met.

We would like to highlight several implications of the equilibrium in Proposition 4. First, it suggests that retailers should not automatically assume that they can sell their entire set of products across the two channels. If indeed the end result is that some product categories won’t sell online, retailers need to be ready to handle the volume of shoppers in stores (and stock accordingly) and may have an incentive to save on any fixed distribution costs associated with allowing online sales. Of course, this does not preclude allowing consumers to view all the products online; but firms may seek to limit the variety that can be purchased online. Second, and somewhat counter to common wisdom that the Internet will prompt retailers to sell esoteric products online, retailers’ assortment on the Internet may actually be limited to the more mainstream products that are associated with less chance of returns. Third, it is important to understand this finding in the context of the options that retailers have. We have shown that there can exist conditions under which retailers will prefer to
offer high enough SA levels to attract all shoppers to the physical store for risky products, rather than offer low SA levels that would induce a portion of consumers to shop for these products online.

Our results seem to be consistent with the practice of several major retailers. For example, Tesco, a leading European retailer, offers many product categories online that it also offers in stores. However, when it comes to apparel, the retailer is willing to let consumers view the products it carries online, but will only allow purchase in its physical stores; with the tagline on its website: “See the styles, Shop in Store” (see Figure 2). Likewise, Meijer, a large grocery and general merchandise retailer operating stores throughout the U.S. Midwest, offers a host of categories. Though it sells various products online; clothing is only offered in its physical stores (see Figure 3).

3.6 Extension: Bricks & Clicks with Different Prices Across Outlets

As we have noted, the majority of retailers offer consistent pricing across their channels (NRF 2006). However, some retailers may find it possible to offer different prices online than in their stores. In this extension, we explore the case of a single product and allow retailers to set different prices on the Internet and in the physical stores. We will use subscripts $S$ and $N$ to denote decisions made in each channel and $BC_d$ will denote the bricks and clicks scenario with different prices across outlets. So that pricing on the Internet matters, we focus on characterizing the equilibrium where sales take place on both channels. Hence, we specify the conditions such that the $k_L$ type consumers purchase in the physical stores while the $k_H$ type consumers buy on the Internet. The following proposition summarizes this equilibrium.

---

12Tesco only allows consumers to browse the different styles online. When it comes to interest in purchase, the online arm prompts the consumer to search for the nearest physical store location.

13Though no academic work to our knowledge empirically tracks the pricing of a given retailer across its online and offline channels, some work has looked at the average disparity of online and offline prices in specific categories. The findings yield mixed results. Early work by Brailey (1998) documenting higher online prices for CDs and books has been later challenged by Brynjolfsson and Smith (2000) and Clay et al. (2000) who show the same or lower prices online. Retailers that have introduced electronic kiosks in stores typically must set prices equally across channels. The contradicting evidence and trends reflect the relevance of examining both price regimes.
Proposition 5  If

\[ k > \frac{\mu(c + r)^2}{3h}, \]  

then there exists a unique sub-game perfect equilibrium where \( k_L \) type consumers always shop in physical stores while \( k_H \) type consumers shop on the Internet. In equilibrium:

\[ \hat{\lambda}_1 = \hat{\lambda}_2 \equiv \hat{\lambda}_{BC_d} = \frac{\mu(c + r)}{3h}, \]

\[ \hat{p}_{N_1} = \hat{p}_{N_2} \equiv \hat{p}_{BC_d}^N = t + r \quad \text{and} \quad \hat{p}_{S_1} = \hat{p}_{S_2} \equiv \hat{p}_{BC_d}^S = t + r(1 - \hat{\lambda}_{BC_d}), \]

\[ \hat{\pi}_1 = \hat{\pi}_2 \equiv \pi_{BC_d} = \frac{1}{2}(t - h\hat{\lambda}_{BC_d}^2). \]

Per our focus, the additional condition (6) ensures that \( k_H \) type consumers don’t have an incentive to buy in stores (given that prices are lower there). The equilibrium outcome reveals several noteworthy findings. First, on the Internet, firms transfer the entire expected cost of handling returns \( (r) \) onto consumers through high prices. Second, as in the Bricks-only scenario, SA levels do not depend on the degree of retailer differentiation. This is because with separate pricing across outlets, there is no need to trade-off revenue from Internet shoppers with the desire to reduce expected returns costs from store shoppers.

We compare the Bricks & Clicks case that allows for different prices across outlets with the Bricks-only benchmark case.

Corollary 4  Assume that the condition of Proposition 5 holds. Then

- \( \hat{\lambda}_B > \hat{\lambda}_{BC_d} \),
- \( \hat{p}_B < \hat{p}_{BC_d}^S < \hat{p}_{BC_d}^N \) and
- \( \hat{\pi}_B < \hat{\pi}_{BC_d} \).

Because pricing decisions online are separate under this Bricks & Clicks scenario, the retailer’s problem in the stores is virtually identical to the Bricks-only scenario, except that this decision is made for only a fraction of consumers. Hence, each retailer chooses SA levels that are lower by a fraction \( \mu \) than in the Bricks-only case. As a result, and somewhat counterintuitively, even prices charged in the stores are now always higher. The flexibility in pricing also leads to unambiguously higher profits.
4 Discussion, Limitations and Concluding Remarks

The advent of the Internet has created an additional way for traditional retailers to make products available to customers. With access to the Internet soon to reach nearly three quarters of the U.S. population, consumers must consider not only which retailer to shop from but also through which channel. Our research has looked at how operating an online selling channel, in conjunction with a physical store, will impact retailer strategies. Our focus has been on categories where the online and offline selling environments differ significantly for consumers: categories where the ability to physically inspect products is important in determining fit. The ability to touch, feel, and benefit from store assistance prior to purchase can significantly reduce the likelihood of returns. Such returns have both supply-side and demand-side cost implications. Beyond examining how the Internet channel is likely to affect pricing decisions, our analysis has also addressed the question of how the store environment is likely to change as a result of the dual channel structure and whether the range of product categories sold in stores will be mirrored online or not. Our results show that these elements of the marketing mix are intimately related and also depend on the degree of retailer differentiation. If such differentiation is high, retailers tend to exploit consumers’ relatively strong brand preferences by charging high prices. In such cases, firms reduce in-store assistance levels relative to the Bricks-only case. The opposite is true if differentiation is low. Hence, we obtained the surprising result whereby the introduction of the online channel can prompt retailers to offer more in-store assistance and make the offline environment even more conducive to finding a match— even though less consumers shop there. We have also analyzed the case of multiple product categories. Here we found that retailers need to be aware that some products will have minimal, if any, online sales. This may help explain why some retailers limit the sales of certain categories to their physical stores. It would also suggest that, for some categories, retailers need to be mindful of how much product to stock in stores, given that all consumers will tend to shop there. Lastly, if pricing can differ across outlets, we have shown that on the Internet firms have an incentive to transfer the entire cost of handling returns onto consumers, while adjusting downward the level of in-store assistance to the relevant market size of offline shoppers. Consequently, prices are higher online and offline.

Our stylized model has several features that merit discussion. On the demand side, we
have formulated the problem in a way that consumers ultimately end up with a product. In making their initial decision, consumers choose the retailer and selling channel with the highest expected utility to them. Implicit in this formulation is that preferences remain constant and that, in the event of a mismatch, having tried the product of one retailer reduces the chances of returns with that retailer for the remaining product variants. This differs from treatments in which consumers are assumed to “exit the market” after a single mismatch incident (typically receiving their money back). We believe our model is realistic in categories where consumers ultimately need the product (i.e., the disutility from not having the product is high), or where store credit is the predominant mode of refund. Our model structure is also static, hence we do not explicitly allow consumers to shop around for a better match at both retail outlets. This is because the primary reason for mismatch in our model is related to an inability to completely resolve uncertainty, before actual usage, associated with the fit of all product variants (color, size, texture, etc.) that each retailer offers.\footnote{For example, a consumer knows she prefers the new jeans styles offered by retailer 1, but is not sure whether a size 6 or 8 would look best on her. We also acknowledge that product returns can result from the good being damaged or malfunctioning. Our focus in this paper is on returns originating from lack of customer fit, in order to highlight this critical aspect of online vs. offline purchasing.}

We also employed a simple two-segment formulation to model consumer heterogeneity in shopping trip costs to visit stores. By allowing the size of the two segments to vary (through the parameter \(\mu\)), flexibility in capturing the characteristics of particular markets is possible. We show in a separate analysis (available from the authors) that even if shopping trip costs are uniformly distributed, our central findings still hold.

On the supply side, we have also made certain modeling assumptions. We have focused on the activities firms invest in to enhance consumers’ ability to physically inspect alternatives in stores. Because of the nature of the products under consideration, such activities are not relevant in the online environment. Providing more digital information on features online will typically have limited ability to assist in mapping horizontal preferences to these kind of products. Furthermore, many retailers now place kiosks in their physical stores, hence, any digital information provided online is also available offline. We have also not incorporated variable costs of providing assistance. This is because the majority of activities we have in mind (such as store capacity to properly feature all variants and sizes, sound rooms, etc.) are fixed in nature. Moreover, we believe decisions regarding SA levels represent up-front
commitment, are longer term and are harder to change relative to prices. It is important to note, though, that firms in our model are free, and in fact do, adjust SA levels as a function of the relevant market size of (equilibrium) in-store shoppers. Finally, we would like to stress that our analysis has centered on how the additional ‘Clicks’ Internet arm affects competing retailers. As such, we have not analyzed situations where the central issue is whether a separate manufacturer will bypass its retailers and sell directly to consumers (for a recent treatment, see Chiang et al. 2003) or how an independent infomediary changes competition in the value chain (see, e.g., Chen et al. 2002).
Appendix

Proof of Proposition 1: Since there is no Internet, each consumer needs to compare $U_{S_1}$ with $U_{S_2}$ see (1). Only consumer heterogeneity in terms of retailer preferences matters because shopping trip costs cancel out. The demand of retailer 1 can be calculated by finding the consumer located at $x$ that is indifferent between the two stores (as each firm sets a single price we denote these as $p_1$ and $p_2$)

$$v - p_1 - tx - c(1 - \lambda_1) = v - p_2 - t(1 - x) - c(1 - \lambda_2).$$  

(A1)

Rearranging terms in (1), the profit function of retailer 1 is:

$$\pi_1 = \frac{p_2 - p_1 + (\lambda_1 - \lambda_2)c + t}{2t} (p_1 - r(1 - \lambda_1)) - \frac{1}{2} h \lambda_1^2.$$  

(A2)

A similar expression exists for retailer 2. Taking first order conditions with respect to prices (holding SA levels constant) and solving the system, one obtains:

$$p_i = t + r + \frac{c(\lambda_i - \lambda_j) - r(2\lambda_i + \lambda_j)}{3i \neq j}.$$  

(A3)

Substituting back in the profit functions and differentiating with respect to SA levels we get the best response SA levels

$$b_i(\lambda_j) = \frac{3t(c + r) - (c + r)^2 \lambda_j}{9ht - (c + r)^2}, \quad i \neq j$$  

(A4)

and solving the resulting system provides the subgame-perfect equilibrium expression in (4). Uniqueness follows from the strict concavity of the profit functions guaranteed under (A9). 

Proof of Propositions 2 and 3: First we deal with the case $k > c$. Clearly, with a single price across distribution outlets (denoted in the proof as $p_1$ and $p_2$) $k_L = 0$ types will never shop on the Internet and will only compare physical stores (as in the proof of Proposition 1). For the $k_H > 0$ type consumers, because prices are the same across outlets and their shopping trip costs are higher than expected returns costs, they only need to compare $U_{N_1}$ with $U_{N_2}$. On the Internet, the indifferent consumer simply satisfies: $v - p_1 - tx - c = v - p_2 - t(1 - x) - c$. Thus, firm 1’s profit will be:

$$\pi_1 = \mu \frac{p_2 - p_1 + (\lambda_1 - \lambda_2)c + t}{2t} (p_1 - (1 - \lambda_1)r) + (1 - \mu) \frac{p_2 - p_1 + t}{2t} (p_1 - r) - \frac{1}{2} h \lambda_1^2.$$  

(A5)
Following the same steps as for Proposition 1 provides the best response functions

\[
b_i(\lambda_j) = \frac{\lambda_j(2\mu^2 c^2 - 5\mu^2 cr + 9\mu cr - 6t(c + r))}{2(\mu^2 c^2 + \mu^2 r^2 - 9ht - 7\mu^2 cr + 9c\mu r)}, \quad i \neq j, \tag{A6}
\]

and solving the system we get the equilibrium results stated in (5). The equilibrium is unique because the profit functions are concave. Also, note that firms cannot deviate to change the qualitative behavior of the two segments. Condition (A9) below ensures that \(0 \leq \hat{\lambda}_{BC} < 1\), and in particular that the denominator of \(\hat{\lambda}_{BC}\) is always positive.

Now let us examine the case when \(k \leq c\). In this case \(k_L\) type consumers shop in the physical stores and \(k_H\) type consumers of retailer \(i\) shop online if and only if \(c\lambda_i \geq k\). There are four possible cases. If both \(c\lambda_1 \geq k\) and \(c\lambda_2 \geq k\), (denote the region by \(SS\)) then \(k_H\) consumers of both retailers shop in the physical stores. Hence the pricing equilibrium is the same as in the bricks only case. Plugging these prices back to the profit function of retailer 2, we get \(\pi_{SS}^{2}(\lambda_1, \lambda_2)\), which is identical to that of the Bricks-only case. Similarly, if both \(c\lambda_1 < k\) and \(c\lambda_2 < k\) (region \(NN\)) then \(k_H\) consumers of both retailers shop on the Internet leading to the pricing equilibrium of the bricks and clicks case with \(k > c\), that we have discussed in the beginning of the proof. Plugging these prices back to the profit function we obtain \(\pi_{NN}^{2}(\lambda_1, \lambda_2)\), the profit function of the Bricks & Clicks case. If \(c\lambda_1 \geq k\) and \(c\lambda_2 < k\) (region \(SN\)) then \(k_H\) type consumers that prefer retailer 1 shop in the physical store, whereas \(k_H\) type consumers that prefer retailer 2 shop on the Internet. Calculating the indifferent consumer in segment \(k_L\) and \(k_H\) and plugging them into the profit functions, we get the equilibrium prices

\[
p_1 = t + r + \frac{\lambda_1(c - 2r) - \lambda_2\mu(c + r)}{3},
\]

\[
p_2 = t + r + \frac{\lambda_2\mu(c - 2r) - \lambda_1(c + r)}{3}.
\]

Plugging these prices back into the profit function we obtain \(\pi_{SN}^{2}(\lambda_1, \lambda_2)\). Similarly we can calculate \(\pi_{NS}^{2}(\lambda_1, \lambda_2)\) in the \(NS\) region. Note that \(\pi_{SS}^{2}(\lambda_1, \lambda_2) < \pi_{SN}^{2}(\lambda_1, \lambda_2)\) and \(\pi_{NS}^{2}(\lambda_1, \lambda_2) < \pi_{NN}^{2}(\lambda_1, \lambda_2)\). The intuition behind this is that at a fixed level of \(\lambda_1, \lambda_2\), firms are better off if consumers shop in the physical stores, since return costs are lower.

Now let us determine the symmetric equilibria in the SA level choice stage. Since the profit functions in the \(SS\) and \(NN\) regions are the same as in the previously discussed cases, the best response functions are identical to those identified in (A4) and (A6), respectively. Hence, whenever the previously determined equilibria fall in the correct region, that is, when \(\hat{\lambda}_B\) falls in \(SS\) and \(\hat{\lambda}_{BC}\) falls in \(NN\), they constitute local equilibria in this case and there are no other symmetric local equilibria.
We still have to check whether these equilibria are global. Since profit functions are symmetric, we only check if firm 2 has an incentive to deviate. In the case of \( \hat{\lambda}_B \) one can check that

\[
\hat{\pi}_B \geq \max_{\lambda_2} \pi_2^{SN}(\hat{\lambda}_B, \lambda_2),
\]

that is, \( \hat{\lambda}_B \) always constitutes a global equilibrium if \( \hat{\lambda}_B \geq k/c \). In the case of \( \hat{\lambda}_{BC} \), it is a global equilibrium if and only if \( k > \overline{k} \), where

\[
\overline{k} = (1 - \mu) \left( 36t^2h^2(1 + \mu) - 4ht(1 + \mu)\mu^2(c^2 + r^2) + (28\mu^2 - 8\mu - 36)\mu crh + 9(1 - \mu)\mu^2c^2r^2 \right).
\]

Note that \( \overline{k} > c\hat{\lambda}_B \), hence we get the equilibrium results stated in Propositions 2 and 3 with

\[
k(c, r, h, t, \mu) = c\hat{\lambda}_B = \frac{c(c + r)}{3h} \quad (A8)
\]

\[\square\]

**Proof of Proposition 4:**

Since the demand for the two products is comprised of disjunct sets of consumers, we can determine the equilibria separately for the two products. Using the results of Propositions 2 and 3, we get the following. If for both products \( k > \overline{k}(c_{\alpha}) = \overline{k}(c_{\alpha}, r, h, t, \mu) \) and \( k > \overline{k}(c_{\beta}) \) then we get the first type of equilibrium for both products described in Proposition 2, where \( k_L \) type consumers always shop in physical stores while \( k_H \) type consumers shop on the Internet and \( \hat{\lambda}_{S_{1\alpha}} = \hat{\lambda}_{S_{2\alpha}} \equiv \hat{\lambda}_{BC}(c_{\alpha}) \), \( \hat{\lambda}_{S_{1\beta}} = \hat{\lambda}_{S_{2\beta}} \equiv \hat{\lambda}_{BC}(c_{\beta}) \) and \( \hat{p}_{1\alpha} = \hat{p}_{2\alpha} \equiv \hat{p}_{BC}(c_{\alpha}) \), \( \hat{p}_{1\beta} = \hat{p}_{2\beta} \equiv \hat{p}_{BC}(c_{\beta}) \). If \( k(c_{\alpha}) \geq k > \overline{k}(c_{\beta}) \), then for product \( \beta \) we get the same type of equilibrium as before, but product \( \alpha \) is only sold in the physical stores. That is, every consumer of product \( \alpha \) shops in physical stores and consumers of product \( \beta \) shop on the Internet if and only if their type is \( k_H \). Store assistance levels are \( \hat{\lambda}_{S_{1\alpha}} = \hat{\lambda}_{S_{2\alpha}} \equiv \hat{\lambda}_{B}(c_{\alpha}) \), \( \hat{\lambda}_{S_{1\beta}} = \hat{\lambda}_{S_{2\beta}} \equiv \hat{\lambda}_{B}(c_{\beta}) \) and \( \hat{p}_{1\alpha} = \hat{p}_{2\alpha} \equiv \hat{p}_{B}(c_{\alpha}) \), \( \hat{p}_{1\beta} = \hat{p}_{2\beta} \equiv \hat{p}_{B}(c_{\beta}) \). If \( k(c_{\beta}) \geq k \), then note that \( k(c_{\alpha}) \geq k \) also holds, since \( k(c) \) is increasing in \( c \). In this case we get an equilibrium where every consumer shops in physical stores and store assistance levels and prices are equal to the bricks only case, that is, \( \hat{\lambda}_{S_{1\alpha}} = \hat{\lambda}_{S_{2\alpha}} \equiv \hat{\lambda}_{B}(c_{\alpha}) \), \( \hat{\lambda}_{S_{1\beta}} = \hat{\lambda}_{S_{2\beta}} \equiv \hat{\lambda}_{B}(c_{\beta}) \) and \( \hat{p}_{1\alpha} = \hat{p}_{2\alpha} \equiv \hat{p}_{B}(c_{\alpha}) \), \( \hat{p}_{1\beta} = \hat{p}_{2\beta} \equiv \hat{p}_{B}(c_{\beta}) \). In any other case there is no symmetric equilibrium.
In summary, we get the results stated in Proposition 4 with

\[
\begin{align*}
k_1 &= k(c_\beta) = c_\beta (c_\beta + r), \\
k_2 &= k(c_\beta), \\
k_3 &= k(c_\alpha) = c_\alpha (c_\alpha + r), \\
k_4 &= \max (k(c_\beta), k(c_\alpha)).
\end{align*}
\]

\[\square\]

Proof of Proposition 5: Given the proposed consumer behavior, firm 1’s profits in the two distribution outlets are the following:

\[
\begin{align*}
\pi_1^S &= \mu \left( \frac{ps_2 - ps_1 + (\lambda_1 - \lambda_2)c + t}{2t} \right) (ps_1 - r(1 - \lambda_1)) - \frac{1}{2}h\lambda_1^2, \\
\pi_1^N &= (1 - \mu) \left( \frac{pn_2 - pn_1 + t}{2t} \right) (pn_1 - r).
\end{align*}
\]

Differentiating with respect to both store and Internet prices that are set simultaneously, and solving as before, we obtain the equilibrium prices and SA levels in (7). In this case, we also need to check under what conditions the equilibrium strategies are consistent with consumer behavior. First, note that \(k_L = 0\) type consumers do not want to switch to the Internet because prices are higher there. \(k_H > 0\) type consumers may consider the stores, however, because lower store prices may compensate them for their higher shopping trip costs. Substituting prices in the utility of a consumer located at \(x\), the condition for \(k_H\) type consumers not to deviate to stores is:

\[
v - (r + t) - tx - c \geq v - (r + t - \hat{\lambda}_{BC_d}r) - tx - (1 - \hat{\lambda}_{BC_d})c - k.
\]

After simplification this condition reduces to (6). We also check that firms do not want to unilaterally deviate by changing consumers’ behavior qualitatively. One deviation is for a firm to attract all consumers to the store by choosing \(\{p_N = \infty \text{ and } p_S < \infty\}\). Assume that firm 1 is the deviating firm. Then, using the equilibrium prices charged by firm 2, denoting \(\lambda = \hat{\lambda}_{BC_d}\), we can calculate firm 1’s demand from the two types of consumers. From the \(k_H\) types the demand is \((r + 2t - ps_1 + \lambda c - k)/(2t)\), and from the \(k_L\) types it is \((r + 2t - r\lambda - ps_1)/(2t)\). With these demands, firm 1’s profit under this deviation is:

\[
\pi_1^D = (1 - \mu) \left( \frac{r + 2t - ps_1 + \lambda c - k}{2t} \right) (ps_1 - (1 - \lambda)r) +
\]
\[
\mu \left( \frac{r + 2t - r\lambda - p_{S_1}}{2t} \right) (p_{S_1} - r(1 - \lambda)) - \frac{1}{2} h\lambda^2.
\]
Differentiating with respect to \( p_{S_1} \) and setting the derivative to 0 we obtain:
\[
p_{S_1} = r + t - \frac{(1 + \mu)\lambda r - (1 - \mu)(\lambda c - k)}{2}.
\]
Substituting this price and \( \lambda \) in \( \pi^D_1 \) and comparing it to \( \pi_{BC_d} \) of the equilibrium, the condition for an unprofitable deviation leads again to (6).

The other deviation is to attract all consumers to the Internet with a \( \{p_N < \infty \text{ and } p_S = \infty\} \) pricing strategy. Following the same steps as before, in this case, the deviating firm’s profit is:
\[
\pi^D_1 = \left( (1 - \mu) \frac{r + t - p_{N_1} + t}{2t} + \mu \frac{r + t - r\lambda - p_{N_1} + t - \lambda c}{2t} \right) (p_{N_1} - r).
\]
Calculating the optimal deviating price and comparing profits under the deviation and the proposed equilibrium, we find that the deviation is not profitable. \( \square \)

**Lower bound on the SA cost factor.** Throughout the analysis we require that \( \hat{\lambda}_{S_i} \in (0, 1) \) and that the profit functions are strictly concave. This means that we need
\[
h > \text{Max} \left\{ (c + r)^2/(9t), \ (c + r)/3, \ \mu(3rc(1 - \mu) + 2t(c + r))/(6t) \right\}.
\] (A9)

The first term in the curly brackets comes from the second order conditions of profit functions in Proposition 1. The second term comes from the requirement that \( \hat{\lambda}_B < 1 \), and the third term from \( \hat{\lambda}_{BC} < 1 \). It can easily be verified that all relevant regions in Propositions 1-5 and Corollaries 1-2 result in non-empty sets with the above conditions.
References


Gentry, C. R. 1999. “Reducing the Cost of Returns; Reverse Logistics, Statistical Data
Included; Panel Discussion”, Chain Store Age Executive, October p. 124.


paper.


Table 1: Summary of Comparative Statics\textsuperscript{15}

<table>
<thead>
<tr>
<th></th>
<th>Bricks-only</th>
<th></th>
<th>Bricks &amp; Clicks</th>
</tr>
</thead>
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<td>$\hat{p}_B$</td>
<td>$\bar{\pi}_B$</td>
<td>$\lambda_{BC}$</td>
</tr>
<tr>
<td>$t$</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>$c$</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$r$</td>
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<td>+ iff $\frac{3h-c}{2} &gt; r$</td>
<td>-</td>
</tr>
<tr>
<td>$h$</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

The table reflects the sign of the derivative of each equilibrium quantity with respect to the parameters in the first column. The unique values of $\mu$ and $r$ are obtained by establishing when the appropriate derivative expressions with respect to $\mu$ and $r$ equal zero.

\textsuperscript{15}
Figure 2: Tesco Limits Sales of Clothing Goods to Physical Stores
Figure 3: Meijer Does Not Sell Clothing Goods Online (Only Sold in Stores)
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