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Prasenjit Mandal

Assistant Professor, Operations Management Group, IIM Calcutta
Phone: 91-9538218853, Email: prasenjitm@iimcal.ac.in

Preetam Basu*

Associate Professor, Operations Management Group, IIM Calcutta
Phone: 91-9007112099, Email: preetamb@iimcal.ac.in

Kushal Saha
PhD student, Management Information Systems Group, IIM Calcutta
Phone: 91-, Email: kushals17@iimcal.ac.in

*Corresponding Author

Indian Institute of Management Calcutta, Joka, D.H. Road, Kolkata 700104

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Prasenjit Mandal[1], Preetam Basu[2],

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Prasenjit Mandal
Indian Institute of Management Calcutta, Kolkata 700104, India, prasenjitm@iimcal.ac.in

Preetam Basu
Indian Institute of Management Calcutta, Kolkata 700104, India, preetamb@iimcal.ac.in

Kushal Saha
Indian Institute of Management Calcutta, Kolkata 700104, India, kushals13@iimcal.ac.in

E-commerce retail has witnessed a steady growth in sales with advances in digital technologies. However, one of the primary challenges that has plagued online retail is its inability to provide customers the opportunity to "touch-and-feel" a product before purchasing, thereby resulting in a higher rate of product returns. To address this, online retailers, nowadays, are adopting various *omnichannel* configurations; such as operating an additional offline channel (i.e. either a showroom or a brick-and-mortar (B&M) store). This paper studies the impact of adopting such an omnichannel configuration on the retailer's profit vis-a-vis customers' strategic behavior. Using a stylized model, we first characterize the retailer's optimal pricing and return penalty decisions under three different scenarios: 1) selling the product online; 2) establishing a showroom ("experience-in-store-buy-online (ESBO)" channel) while selling the product online; and 3) selling the product through both B&M store and the online channel, while allowing in-store product returns ("buy-online-and-return-in-store (BORS)" channel). Additionally, we compare the retailer's profit across various scenarios and propose several key managerial insights. Based on product attributes such as product standardization and product valuation, we recommend optimal omnichannel strategies for the retailer. For example, if the product is premium and highly customized (e.g. designer apparel), the retailer should open an additional showroom.

Key words: E-commerce; Omnichannel retailing; Product returns; Showrooms; Store returns
History:

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1. Introduction

Over the last decade, the online retailing industry has seen an unprecedented growth enabled by advances in technology-driven and internet-enabled devices - e.g. smartphones and laptops (Bell et al. 2014, Gao and Su 2016a, Bell et al. 2017). In 2018, the US e-commerce annual retail sales reached $525 billion; it is expected to grow steadily to reach $893 billion mark by 2020 (eMarketer 2018). Many traditional brick-and-mortar (B&M) retailers are now investing heavily in digital technology to offer an improved online shopping experience to their customers. For example, big-box retailers like Target and Kohl have invested $7 billion and $2 billion respectively, for digital

“[illegible]” (FedEx 2018).

On the other hand, customers find the process of returning misfit products troublesome. In a Forrester survey, 51% of online customers expressed their concerns regarding product returns as there is an opportunity cost associated with the wait for the refund amount (Ofek et al. 2011). Additionally, some retailers even impose a fixed fee (as a return shipping or a restocking fee) for product returns (e.g. - H&M charges $5.99). In some cases, restocking fee typically ranges from 10% to 25% of the product price. However, this extra shipping fee for returning items discourages customers from buying online Abdulla et al. (2019). Not surprisingly, customers are worried about the return policy enforced by retailers. A recent study by UPS reveals that a large majority of customers (approximately 66 percent) check an online retailers' return policy before shopping online (WSJ 2017). Thus, customer returns has long been considered to be a crucial issue, thereby forcing retailers to seek strategies to mitigate the challenges of product returns.

To address the challenges associated with product returns, many retailers have started adopting a multi-channel product distribution approach by o□ering products through both web-based digital channels and physical o□ine stores (Wolf 2018). Pure-play online retailers such as Alibaba have extended their o□ine arms by building a large number of physical stores (JDA Software Group Inc. 2017, Wolf 2018). However, for a pure multi-channel retailer, both channels typically work in silos and have very little interaction among them (Orendor□ 2018). For instance, customers cannot return (pick up) products, that they have already purchased, to (from) a store, which, IInrntowar ove49

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Table 1 Product Standardization-Product Valuation Matrix

Product Standardization	Product Valuation	
	High	Low
High	Laptop, Refrigerator, AC	Groceries, Books, DVDs
Low	Designer Apparel, Jewelry,	Footwear, Eyewear, Swimsuit

by an online retailer to mitigate the challenges associated with product returns. More specifically, we seek to answer the following research questions:

- How does the introduction of an omnichannel configuration, either a showroom (ESBO channel) or an integrated B&M store with the BORS option, affect an online retailer's profit?
- Under what conditions and for which products, is it profitable for an online retailer to introduce a showroom or an offline B&M store?
- How do the omnichannel strategies affect the online retailer's pricing and return penalty decisions?

To address these questions, we develop a stylized model to identify an online retailer's optimal pricing and return penalty decisions under three different scenarios: 1) selling only through a web-based online channel; 2) establishing a showroom (ESBO channel) while selling only through the online channel; and 3) selling through both B&M store and online channel while allowing in-store product return (BORS channel). The retailer (addressed as "she") procures and sells her product to end-customers. The product may not match a customer's expectations in terms of product fi[illegible] (i.e. product misfit or quality mismatch). To ensure that the customers do not hesitate to shop online because of this fit uncertainty, the retailer allows them to return their misfit products. However, the customers incur hassle costs while purchasing and/or returning products online. Additionally, the retailer charges a restocking fee (return penalty) for each item being returned. Thus, both the return penalty and hassle cost act as deterrents to customers for shopping online. In order to overcome these challenges, the online retailer intends to set up an additional physical store in the form of a showroom or a B&M store. Herein, the retailer brings such innovative strategies to mitigate the propensity of customer returns.

1.2. C[illegible]

A list of key insights and contributions are as follows.

First, we find and characterize further the optimal pricing and return penalty decisions under all three scenarios. From our analysis we find that as the unit return transportation cost increases, the optimal product price (optimal return penalty) decreases (increases). The reason behind this the retailer's optimal pricing and return penalty decisions under the "showroom" (i.e. adding the

Gallino and Moreno (2014) empirically evaluate the worth of buy-online-pickup-in-store (BOPS) strategy and show that it leads to a reduction in online sales, but a rise in brick-and-mortar store tra□c and sales. Harsha et al. (2016) compare omnichannel fulfillment strategies, such as ship-to-store and BOPS with a retailer's existing sales strategy and through experiments, showing that omnichannel strategies do lead to shorter delivery time, larger sales and greater revenue. Govindarajan et al. (2017) obtain optimal order-up-to quantities while comparing three omnichannel strategies: full integrated, partially integrated, and individual fulfillment. Govindarajan et al. (2018) generalize Govindarajan et al. (2017) by considering a network of traditional physical stores and online fulfillment centers. Gallino et al. (2016) use proprietary data from a US retailer to show that newly implemented ship-to-store functionality has increased its overall sales dispersion. (Bayram and Cesaret 2020) investigate dynamic fulfillment decisions for online orders in a ship-from-store context. Park et al. (2020) develop a mixed integer programming formulation while maximizing the expected customer showcasing utility for a retail store. Additionally, they conduct a comprehensive case study based on data obtained from 17 dealership to show the practicality of their approach.

Extant literature also considers the impact of opening a physical store, while adopting omnichannel functionalities; e.g. cross-channel purchasing or showrooming, on a retailer's profit (Verhoef et al. 2015, Melacini et al. 2018, Mou et al. 2018). Bell et al. (2017) empirically show that introemployment levels, and the retailer's profit. Nault and Rahman (2019) investigate the roles physical stores in mitigating online disutility costs (arising from shipping and handling costs, privacy and security issues, trust issues, di culty in fit assessment, and lack of after-sales support associated with online purchases) for a dual-channel retailer in a competitive environment. Li et al. (2020) examine the e ect of di erent physical showroom deployment strategies – no showrooms, showrooms with partial assortment, and showrooms with full assortment – on information service provision, pricing, and profitability of an omnichannel retailer. Recently, Lin et al. (2020) study the impact of BOPS strategy on product quality, retail price, along with the manufacturer's and retailer's profits. Additionally, they find that the adding a BOPS channel may actually benefit both the manufacturer and the retailer.

In comparison to the studies mentioned above, we investigate the optimal channel configuration for an online retailer while adopting an omnichannel strategy based on product characteristics. To mitigate the costs associated with product returns from online shoppers, a retailer tends to consider two omnichannel configurations, i.e. – establishing a physical showroom or opening a B&M store. Our study contributes to the extant literature by developing a decision support matrix in terms of the optimal omnichannel configuration.

2.2. C[illegible] R[illegible]

Our work also relates to literature on product returns, which is a common phenomenon in online retailing. Academics in the Marketing and Operations management areas have long been studying the impact of return policy on customers' purchase and return decisions, as well as the retailer's profit (see a few earlier works of Davis et al. (1995), Davis et al. (1998), Matthews and Persico (2005), and Matthews and Persico (2007)). Recently, (Abdulla et al. 2019) provide an extensive

showroom. Additionally, we explore how adopting an omnichannel strategy, such as showrooming or BOPS, does affect the retailer's profit. Gao et al. (2019) study the problem of determining the number and size of physical stores in an omnichannel setting that considers both showrooming and in-store customer returns. Jin et al. (2019) identify conditions under which either/both retailers adopt the "buy-online, return-to-physical store" (BORP) option in a duopoly setting. However, our work is significantly different from both Gao et al. (2019) and Jin et al. (2019) in omnichannel return context as it also considers a partial refund policy. Furthermore, we conduct a comparative analysis between showrooming, BORS and a pure online format. Additionally, we consider a scenario where customers may decide to exchange the returned product in a B&M store (Ertekin 2018).

3. M

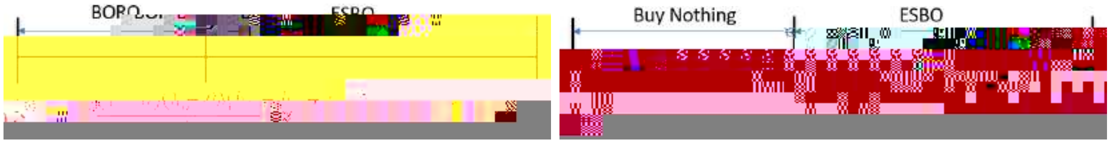
We consider a stylized model in which a retailer ("she") sells her products in a downstream consumer market through an online channel. Ex ante, customers are uncertain whether the product fits their needs. If they buy the product online, they do not have the option of experiencing it before purchasing. Therefore, in order to incentivize the customers, and to negate the uncertainty associated with the product , the online retailer provides an option of returning the items that do not conform to the customer's requirements. Herein, may we add that the product non-conformity could be in terms of "fit", "quality mismatch" or "features" offered by the product itself; and managing these product returns does pose a huge challenge for t T* [(itself;m18.4.6emfma()-389((Jin

3.1. B[illegible]: R[illegible] O[illegible]

As a benchmark, we first analyze a scenario where the retailer operates an online store only. We call this strategy as the “[illegible] ([illegible])”. Herein, customers cannot evaluate certain features of the product if they purchase it from an online channel. Even though a customer can gather product information by other means, such as word-of-mouth and online reviews, he makes the decision of keeping the product once he receives it based on whether the product conforms to and fits his requirements. The customer incurs a hassle cost $h >$

4. O[illegible] R[illegible] M[illegible] C[illegible] R[illegible]

Figure 1 **Customer Segmentation if a showroom is opened**



(a) A fraction of customers prefers BORO (b) No customer prefers BORO

customers are segmented in the above two cases. The following lemma summarizes the strategic customer behavior (see Figure 1). Next, Lemma 2 illustrates how the consumer market are segmented based on the customers' purchasing behaviors.

Lemma 2. [illegible]

(a) [illegible]: $0 \leq x \leq$ [illegible], [illegible]; [illegible] $< x \leq 1$, [illegible].

(b) [illegible]: $0 \leq x \leq$ [illegible], [illegible]; [illegible] $< x \leq 1$, [illegible].

The lemma implies that, depending on the value of p, there could be two distinct cases. If $p \leq$ [illegible] (the retail price is relatively low), i.e. $\mathcal{U} \geq 0$, customers buy the product online irrespective of them visiting the showroom. However, there could be other scenarios from the customer behavior perspective: visit the showroom and buy online, and buy online without visiting the showroom. A customer located at x prefers ESBO strategy if $0 \leq x \leq$ [illegible] and to buy from the online channel if [illegible] $< x \leq 1$. If $0 \leq x \leq$ [illegible], a customer is located closer to the showroom. Hence, he will purchase the product from the online channel after experiencing it in the showroom and finding it a good match. The retailer's problem is to decide the retail price, p, and the return shipping fee, f that maximize her profit:

$$\text{Case S}^{I}: \max \left\{ \Pi (p, f) = \theta(p-c) - \left(1 - \frac{(1-\theta)(h + h + f)}{k}\right)(1-\theta)(t-f) \right\} - F_1 \qquad (2)$$

$$s.t.\ p \leq \frac{\theta V - h - (1-\theta)(h + f)}{\theta}.$$

If $p >$ [illegible], i.e. $\mathcal{U} < 0$, some customers do not buy the product at all because of high retail price. Then, there could be two optimal customer behaviors: (i) visit the showroom and buy online, and (ii) do not purchase at all. Thus, a fraction of customers buys the product from online channel, only after inspecting it in the showroom. A customer located at x prefers ESBO strategy if $x \leq$ [illegible]; otherwise he prefers not to purchase. Then, the retailer solves the following optimization problem:

$$\text{Case S}^{I}: \max \left\{ \Pi (p) = \theta(p-c)\frac{\theta(V - p - h)}{k} \right\} - F_1 \qquad (3)$$

$$s.t.\ p > \frac{\theta V - h \ - (1-\theta)(h \ + f)}{\theta}.$$

Next, in Proposition 1, we characterize the optimal retail price and return penalty decisions when the retailer establishes a showroom.

Proposition 1. [illegible]

(a) [illegible]

Corollary 1. [illegible] h, h, [illegible] t.

It becomes clear from Corollary 1 that when the hassle cost related to online buying and returning as well as the transportation cost associated with online returns increase, more number of customers would prefer to buy the product after inspecting it in the showroom. Thus, retailer's profit difference between "with showroom" and "without showroom" scenarios increases when either of h , h , or t

customers are mostly inconvenienced by two contrasting characteristics of returns: (i) paying a restocking fee in case he returns online (27% of customers), and (ii) irritation of traveling to a physical store for returning a product (21% of customers) (UPS 2016). Another UPS study, conducted in 2018, reveals that 58% online customers in the US, preferred in-store returns, whereas 45% customers actually returned products in conventional stores (UPS 2018). Retailers can fulfill the BORS, (ii) Case S^{II}, $p \leq \frac{- \;_o-(1- \;)(\;_r+\;)}{}$ and $f > \frac{\;_o}{} - h$, where a fraction of customers prefer the BORS, and (iii) Case S^{II} , $p > \frac{- \;_o-(1- \;)(\;_r+\;)}{}$ and $f > \frac{\;_o}{} - h$, where no customer prefers the BORO. These three cases characterize customer x's optimal shopping behavior. The strategic customer behavior is characterized in Lemma 3 (see Figure 4).

Figure 4 Customer Segmentation if a B&M Store is opened

(a) No customer prefers the BORS (b) A fraction of customers prefer the BORS (c) No customer prefers the BORO

Lemma 3. [illegible]
( ) [illegible] ^{II}: $0 \leq x \leq \frac{(1-\;)(\;_r+\;)+\;_o}{}$, [illegible];
$\frac{(1-\;)(\;_o+\;_r+\;)}{} < x \leq 1$, [illegible] .
( ) [illegible] ^{II}: $0 \leq x \leq \frac{\;_o}{}$, [illegible]; $\frac{\;_o}{} < x \leq \frac{\;_r+}{}$, [illegible]; $\frac{\;_r+}{}$

Next, we discuss the cases (ii) and (iii) where $f > \frac{\ _o}{\ } - h$. If $\mathcal{U}$ ≥ 0, i.e. $f > \frac{\ _o}{\ } - h$ and $p \leq \frac{- \ _o - (1- \ )(\ _r + \ )}{\ }$, the retailer keeps the product price low to serve all the customers, and return retailer keeps the return penalty low so that she can serve all the customers. As the return penalty is kept low, the customers who have already spent the hassle cost to buy it online, are not willing to pay an additional travel cost for returning the item in store. Thus, she acts like a multichannel retailer in absence of cross-channel returns. In Case S^{II}, the unit return transportation cost is moderate. In this case, a customer located at x either visits the B&M store or follows the BORO or the BORS strategy so that he maximizes his utility. The competition between these strategies intensifies, thus resulting in a lower price and retailer's profit as compared to Case S^{II}. Finally, in Case S^{II}, we find that as the unit return transportation cost is high, no customer prefers the BORO strategy for shopping. Hence, all customers either visit the B&M store or follow a BORS strategy for shopping from the retailer. Because of high return penalty and misfit uncertainty, these customers visit the store for either purchasing or returning a product. The remaining customers do not buy the product. Proposition 3 also highlights how the retailer's profit changes with respect to t. Intuitively, a higher return transportation cost makes online shopping less attractive to customers, and thus, the retailer's market price and profit (weakly) decrease in each case. Figure 5a and 5b highlight the impact of the return transportation cost on the optimal retail price and retailer's profit, respectively.

Figure 5 Impact of t on retailer's market price and profit

(a) Retailer's market price as a function of t

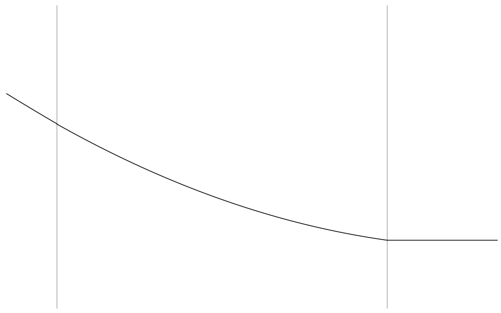
(b) Retailer's profit as a function of t

Corollary 2. $(i.)\ p \quad > p$

surplus from customers. However, in Case S^{II}, the retailer sets a high return penalty to compensate for the high cost of reverse logistics. But, she offers a low retail price to attract more customers for shopping. In Proposition 3, we show the influence of h , h , and t on the relative benefit of establishing a B&M store. Next, in Proposition 4, we compare the retailer's pricing and return penalty decisions under the "showroom" (adding the ESBO channel) and the "B&M store" (adding

Our result from Proposition 5 follows from comparing the retailer's profit with and without establishing a B&M store. When the unit return transportation cost (t) is low, the retailer sets a low return penalty. As a result, customers prefer online shopping as compared to visiting the B&M store. The retailer in turn finds no incentive to open a B&M store in addition to the online channel. On the other hand, when t is high, the retailer sets a high return penalty. As a result, some of the customers choose not to buy from the online channel, thus, to attract those customers, the retailer establishes an additional B&M store.

Figure 6 Retailer's profit comparison with respect to t



5. D[illegible] M[illegible] P[illegible] E[illegible] P[illegible]

We first consider the potential impact that the product characteristics, namely the extent of product valuation and product standardization, can have on determining the online retailer's optimal omnichannel strategy. As mentioned earlier, the misfit uncertainty associated with online purchases

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Table 3 Omnichannel configurations based on product standardization and product valuation

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