Offline-Online Retail Collaboration via Pickup Partnership

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We study a growing retail strategy called *pickup partnership*, where online retailers partner with physical stores to offer in-store pickup services. In practice, two main policies are used in these partnerships: (i) a *fixed fee policy*, where the retailer pays the offline partner a set fee per pickup order, and (ii) a *coupon policy*, where customers receive a coupon for use at the offline partner's store with each pickup order. Our goal is to evaluate these policies and determine which is most beneficial for online retailers. We develop a stylized model that captures the essential dynamics of pickup partnerships. We find that while the coupon policy allows the online retailer to gain greater market coverage compared to the fixed fee policy, it does not always lead to higher profits for the online retailer. The coupon policy is preferred when in-store fulfillment and pickup handling costs are low and direct-delivery costs are high, whereas the fixed fee policy is favored when these costs are moderate. We also find that both policies entail inefficiencies when the incentives of the two parties are not aligned. To alleviate such inefficiencies, we propose a new policy designed to better align incentives and improve partnership efficiency. This paper offers the first theoretical analysis of the in-store pickup partnership model and provides practical guidance for online retailers seeking to implement it. Our proposed policy aims to enhance the effectiveness and profitability of these partnerships beyond current industry practices.

Key words: in-store pickup service, partnership, omnichannel retailing, retail operations

1. Introduction

Rising customer demand for convenience in shopping (Boston Retail Partners 2021) has intensified competition between pure online retailers and multichannel retailers. To stay competitive, many multichannel retailers have leveraged their physical presence to enhance the customer experience by offering in-store pickup–a service that allows customers to pick up online orders at physical store locations (Gao and Su 2017). This service has rapidly gained popularity for its convenience, and in 2020, in-store pickup sales in the United States doubled compared to the previous year, with projections indicating continued growth of at least 15% annually (Chevalier 2021). In response, pure online retailers have recently started forming strategic partnerships with brick-and-mortar retailers (referred to in this paper as offline partners) to offer similar services, a model referred to as *pickup partnership*.

A pickup partnership enables an online retailer to use an offline partner's stores as pickup locations for customers who prefer to pick up their online orders from a nearby store at no additional shipping cost. Under this fulfillment option, the online retailer ships the order to the offline partner store chosen by the customer and notifies the customer when the order is ready for pickup. The offline partner's staff handles the handoff and confirms completion of the pickup with the online retailer. A prominent example is Amazon Hub Counter (AHC), where Amazon partners with physical retailers to offer assisted pickup locations for customer orders. Participating retailers include Rite Aid, GNC, Health Mart, and Stage Stores in the United States, NEXT in the U.K., Librerie Giunti al Punto, Fermopoint, and SisalPay in Italy, and ParcelPoint in Australia. Similarly, Uniqlo, a Japanese fashion retailer, has partnered with over 5,700 7-Eleven stores in Tokyo to offer in-store pickup services.[1]

Pickup partnerships offer a range of benefits to both online retailers and offline partners. For online retailers, providing an in-store pickup option can boost sales while also lowering fulfillment costs. Compared to direct delivery to home (referred to in this paper as direct-delivery), shipping orders to a partner store can reduce expensive last-mile delivery costs by allowing order consolidation (Morganti et al. 2014, Ishfaq and Raja 2018). Offline partners, in turn, benefit from increased foot traffic, which can drive additional sales through cross-selling. Notably, 45% of customers who use in-store pickup services make an additional purchase during their visit (UPS 2015). Additionally, online retailers often compensate offline partners for each pickup handled, providing an additional revenue stream for offline partners. Given these mutual benefits, the trend of forming pickup partnerships is likely to persist or even expand in the future.

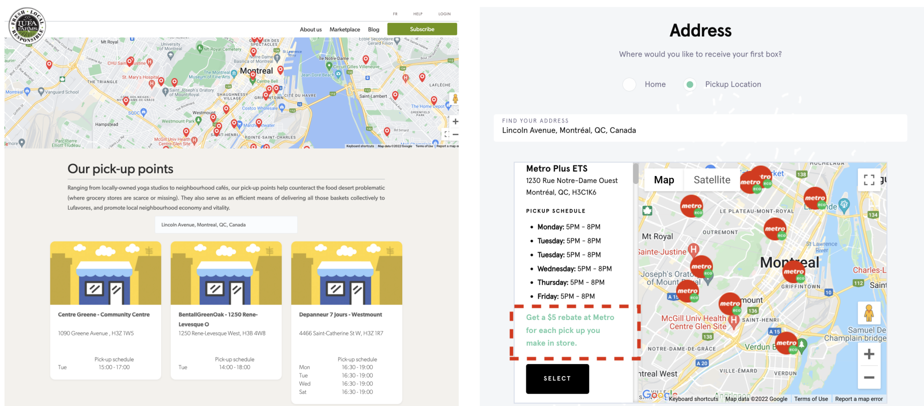
This trend raises the question of the best way to establish pickup partnerships between online retailers and offline partners. In practice, we observe two different policies (see Figure 1 for illustrative examples). The first is the *fixed fee policy*, where the online retailer pays the offline partner a fixed commission for each in-store pickup order (Morganti et al. 2014, Fang et al. 2019).[2] This model is used in partnerships such as between Maturin and LOCO, Lufa Farms (a Canadian online grocery retailer) and local stores (Figure 1(a)), and Amazon with thousands of AHC retail partners.[3] The second is the *coupon policy*, where the online retailer issues a coupon to customers who

[1] `https://www.fashionnetwork.com/news/Uniqlo-japan-launches-in-store-pickup-service-with-7-eleven,625015.html`

[2] `https://business.amazon.com/en/discover-more/blog/amazon-hub-delivery`

[3] `https://www.pudoinc.com/member-benefits/pudopoint-counter/`

choose in-store pickup. This coupon can be redeemed for a discount on a purchase at the offline partner's store. If redeemed, the online retailer reimburses the offline partner for the discounted amount. An example of this policy is the partnership between Cookit (a meal-kit retailer) and Metro (a Canadian grocery retailer), illustrated in Figure 1(b). It is worth noting that while the compensation for each in-store pickup order is similar between the two policies, the key difference lies in the payment's recipient. In the fixed fee policy, the payment goes directly to the offline partner, whereas in the coupon policy, it is directed to the customer, making the two policies structurally different.



(a) Lufa Farm and Local Stores (b) Cookit and Metro

Figure 1 Illustration of the Fixed Fee Policy (Left) and the Coupon Policy (Right)

When forming a pickup partnership, should an online retailer compensate the offline partner directly through a fixed fee, or incentivize customers with a redeemable coupon? Despite the growing prevalence of such partnerships, we are not aware of any academic research that addresses these questions. From a practitioner's perspective, the fixed fee policy may be appealing because it provides offline partners with a readily visible and predictable revenue stream. Conversely, the coupon policy may also be attractive, as it incentivizes customer visits, potentially increasing foot traffic and cross-selling opportunities for the offline partner. Overall, it is not immediately evident which policy is more advantageous. This motivates our first two research questions: *How should an online retailer choose between the fixed fee and coupon policies when establishing a pickup partnership? What types of online retailers are better suited to each policy?*

The presence of fixed fee and coupon policies in practice does not necessarily guarantee that they lead to efficient pickup partnerships. Fundamentally, a pickup partnership functions as a contract between two parties. Research in supply chain contracting (see Tsay et al. 1999) has shown that inefficiencies are common in practice (Loch and Wu 2008) and arise due to misaligned contractual incentives (Pavlov et al. 2022). Viewed through this lens, pickup partnerships may also suffer from similar inefficiencies if the incentives of the online retailer and offline partner are not aligned. This perspective gives rise to our next two research questions: *Do fixed fee and coupon policies lead to inefficient pickup partnerships? If so, can we design an alternative policy that better aligns incentives and improves efficiency?*

To answer our research questions, we develop a stylized model that captures the essential features of a pickup partnership. We consider an online retailer who sells a product exclusively through an online channel and is evaluating the option to offer an in-store pickup service through a partnership with an offline partner. The online retailer's objective is to maximize her profit while ensuring the partnership is also beneficial to the offline partner. When the pickup partnership is established, customers choose between direct-delivery and in-store pickup to maximize their utility. We first analytically examine how each policy affects customer demand and the profits of both partners. We identify conditions under which a pickup partnership is mutually beneficial, meaning both partners earn higher profits (in a non-strict sense) under the pickup partnership than they would without it. Armed with these results, we compare the two policies and characterize when each policy is optimal for the two parties. We then infer what type of online retailers are more suitable for the fixed fee policy versus the coupon policy when establishing a pickup partnership. Lastly, we examine the conditions under which the two policies lead to inefficiencies and propose an alternative policy, termed the *hybrid policy*, to mitigate those inefficiencies.

Our study makes several contributions. First, we find that establishing a pickup partnership (regardless of policy) affects the demand for the online retailer's product in two distinct ways: (i) it enables the online retailer to expand its market coverage due to the increased convenience of the in-store pickup option; (ii) it incentivizes some existing customers to switch their delivery mode from direct-delivery to in-store pickup. While the former effect (i.e., market expansion) on demand increases the online retailer's profit, the latter effect (i.e., demand shift) can actually hurt the online retailer's profit if in-store pickup orders yield lower margins than direct-delivery orders. Hence, the pickup partnership is only beneficial when these two demand streams result in a net profit gain. Second, our results reveal that the two demand streams induced by the partnership are amplified under the coupon policy. In addition to the convenience of the in-store pickup option (as in the fixed fee policy), the coupon provides an additional incentive that attracts more customers to choose in-store pickup. However, if in-store pickup fulfillment is less profitable, on a per-item basis, than direct-delivery, this increase in pickup demand may erode the online retailer's profit. Thus, selecting between the fixed fee and coupon policies requires a careful assessment of both partners' cost structures. Third, we examine the role of the offline partner's cost structure in determining the optimal policy. When the offline partner has low handling costs, the coupon policy is preferable, as the online retailer can offer lower compensation per order while maintaining a healthy profit margin. The additional demand generated under the coupon policy then becomes profitable. If the offline partner has moderate handling costs, the fixed fee policy is more suitable. However, if handling costs are high, a partnership may only be viable with high compensation, so that the online retailer is better off not establishing a pickup partnership. Fourth, we analyze how the online retailer's cost structure influences the partnership's viability. Pickup partnerships are not attractive for online retailers with low direct-delivery costs or high in-store pickup costs. Otherwise, the fixed fee policy is preferable for online retailers with moderate direct-delivery costs, moderate in-store pickup costs, or low-priced products, whereas the coupon policy is better suited to online retailers with high direct-delivery costs, low in-store pickup costs, or high-priced products. Finally, while our model suggests that both policies used in practice can lead to a profitable pickup partnership, it remains unclear whether these policies fully unlock the potential value of such partnerships. In fact, we find that both policies can lead to inefficiencies, in the sense that even the optimal policy between them may impose an opportunity cost on the online retailer. This occurs when the retailer must accept a suboptimal compensation structure to make the partnership viable. To address this issue, we propose a new hybrid policy that leverages the features of both the fixed fee and the coupon policies. In particular, the hybrid policy allows the online retailer to split the total compensation: part is paid directly to the offline partner as a fixed fee, and the remainder is offered to customers as a redeemable coupon. This flexible structure helps better align incentives and capture the strengths of both original policies. Our numerical analysis reveals that inefficient pickup partnerships under current policies are common and that the hybrid policy can yield significant improvements for the online retailer.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 formalizes our model. In Section 4, we analyze the model and derive key analytical results. Section 5 explores various model extensions. In Section 6, we examine policy-induced inefficiencies and introduce the hybrid policy. Section 7 concludes and discusses the managerial implications of our findings.

2. Literature Review

This paper is related to three streams of literature: in-store pickup services, retail partnerships, and coupon promotions.

In-Store Pickup Services. The recent growth of in-store pickup services (e.g., click-and-collect and ship-to-store) has led to an increase in research on that topic. The literature has examined two types of in-store pickup services: buy-online-pickup-in-store (BOPIS) and ship-to-store (STS). The major difference between the two is the order fulfillment point. BOPIS orders are fulfilled using store inventory and can thus only be placed for products available in a store (Gao and Su 2017, Ishfaq and Raja 2018), whereas STS orders are fulfilled using the distribution center inventory and can be placed for any product available online, regardless of whether it is stocked in any store (Ertekin et al. 2022).

Gallino and Moreno (2014) empirically show that even though using BOPIS can reduce online sales, the sales generated from the additional store traffic can make retailers better off when offering such services. Focusing on individual products, Gallino et al. (2017) find that STS services may shift sales from high-selling products to low-selling products. In the same vein, Ertekin et al. (2022) find that STS has a heterogeneous effect on sales of online-only products versus products available both online and offline. The authors conclude that considering the STS effect when choosing channel(s) to sell a product can improve the performance of in-store pickup services. Akturk and Ketzenberg (2022) evaluate the competitive impact of BOPIS. They show that both online and store sales at a focal retailer are adversely affected after the competitors' launch of a BOPIS service. Focusing on customer behavior, Song et al. (2020) find that BOPIS has a positive effect on offline purchase frequency and on online purchase amounts. Glaeser et al. (2019) demonstrate that the location of the pickup stores can have a significant effect on BOPIS profitability.

Among analytical studies, Gao and Su (2017) examine the impact of BOPIS on store operations. The authors find that despite enabling retailers to increase demand from new customers, BOPIS may not be suitable for products that sell well in stores. Hu et al. (2022) demonstrate that retailers can leverage the additional demand induced by BOPIS to improve their store fill rates. Ertekin et al. (2022) illustrate that when implementing STS, retailers should offer easy-to-substitute products only online and difficult-to-substitute products both online and in stores. Similarly, Cao et al. (2016) find that in-store pickups may not be suitable for all products. Gao et al. (2022) show that it might be optimal for retailers to reduce their physical store presence under BOPIS. Finally, Chen et al. (2024) show that BOPS adoption generally increases inventory across both online and offline channels. When inventory ordering costs are high and cross-selling effects are moderate, retailers tend to close the BOPS channel regardless of inventory constraints.

The studies in this literature primarily examine in-store pickup services when the retailer owns both the online and offline channels. In contrast, our paper investigates in-store pickup services when offered by a pure online retailer that partners with an offline store. Thus, some of the highlighted benefits of BOPIS or STS for multichannel retailers will not be present for online retailers under the pickup partnership. More importantly, unlike the implementation of a pickup partnership, which can follow different policies (i.e., fixed fee vs. coupon policies), the implementation of traditional in-store pickup services (whether BOPIS or STS) is quite standard . Therefore, existing studies on traditional in-store pickup services cannot help identify which policy online retailers should use when establishing a pickup partnership. Overall, we contribute to this literature by developing a theoretical model (i) to demonstrate when and how a pickup partnership should be established, (ii) to identify how online retailers should choose between fixed fee and coupon policies, and (iii) to propose an alternative policy to improve the pickup partnership efficiency.

Retail Partnerships. These kinds of partnerships have been studied in several settings, ranging from supply chain contracts and coordination (Cachon and Lariviere 2005, Chung et al. 2014, Li and Yu 2017, Vairaktarakis and Aydinliyim 2017, Jia et al. 2024) to coalition and coopetition contracts (Nagarajan and Sošić 2007, Cohen and Zhang 2022, Yuan et al. 2021). Our work is closely related to a growing stream in this literature that studies offline-online partnerships to enhance omnichannel retailing offerings, such as buy online, return in-store (Hwang et al. 2022, Nageswaran et al. 2024) and search offline, buy online (i.e., showrooming) (Dan et al. 2021). In this stream, Nageswaran et al. (2024) theoretically examine the potential of a return partnership between a pure online retailer and an offline partner that serves as the in-store return location for the online retailer. The authors find that such a return partnership can be formed either when there is only a small product assortment overlap between the two parties, or when the offline partner has a small number of physical locations. Hwang et al. (2022) empirically show that such return partnerships generate additional sales for the offline partner. Most studies on offline showrooming focus on a single company (e.g., Bell et al. 2018, Gao et al. 2022). Dan et al. (2021) analytically study how an online retailer should choose between competing and non-competing offline retailers to offer a physical showrooming service and how the type of offline retailer (competing or non-competing) can affect an online retailer's pricing strategy under an exogenous commission fee. In these studies, the focus is primarily on the types of offline partners that should be selected as partners. By contrast, our study focuses on how online retailers should select partnership policies according to offline partners' characteristics. Even when we extend our review to the broader retail partnership literature, we could not find any study with guidance on how online retailers and offline partners should establish a pickup partnership. We contribute to this stream by studying the impact of the two pickup partnership policies on the decisions and payoffs of the key stakeholders.

Coupon Promotions. There is a large literature stream on coupon redemption (e.g., Danaher et al. 2015), coupon effects on customer behavior (e.g., Dogan 2010, Reimers and Xie 2019, Baardman et al. 2019). We position our work with respect to papers that consider the role of coupon promotions in channel coordination. Among those, Martin-Herran and Sigué (2015) find that manufacturers prefer coupon promotions over a cooperative pricing strategy. Li et al. (2020) evaluate how issuing coupons by either manufacturers or retailers can affect the supply chain profit. Pauwels et al. (2011) show that offering online promotions can also increase the demand for the offline channel, creating a channel synergy effect. Despite all these valuable contributions, there is no study that leverages coupons to facilitate a pickup partnership between an online retailer and an offline partner. Our study contributes to this literature by demonstrating how a coupon promotion can be used to design an effective mechanism for pickup partnerships.

3. Model Description

In this section, we develop a stylized model to characterize the key features of a pickup partnership between an online retailer and an offline partner. In the following subsections, we describe our modeling framework, introduce a baseline policy in which the pickup partnership does not exist, and consider two different pickup partnership scenarios by building on the baseline policy.

3.1. Modeling Framework

The model consists of an online retailer that sells a product through its online channel at price p. Consistent with the literature that models interactions between retailers and customers using the circular location model (e.g., Balasubramanian 1998, Shulman et al. 2009, Gao et al. 2022), we assume that the online retailer serves customers who are uniformly distributed on the circumference of a circular city with a circumference of one (Salop 1979). The online retailer's warehouse is located at the center of the circular city and is thus equidistant from all customers. Without loss of generality, we assume that the size of the market is normalized to one.

To provide customers with an in-store pickup service for online orders, the online retailer considers establishing a partnership with an offline partner. When such a partnership does not exist, the online retailer can only offer a direct-delivery option to its customers under which orders are shipped directly to customers. If a pickup partnership is established, in addition to the direct-delivery option, customers are given a free in-store pickup option. With this option, the online retailer ships orders to the offline partner, and customers pick up their orders by visiting the offline partner at their convenience. We assume that the offline partner has one store and it is randomly located on the circumference of the circle (in Section 4, we discuss the model where the offline partner has more than one store). We also assume that the product sold by the online retailer is not offered by the offline partner.

Customers: We assume that customers make purchasing decisions based on their utility. The valuation of product is v for all customers. If customers opt for the direct-delivery option, they incur a "hassle" cost h_o that includes both the shipping cost and the inconvenience of waiting for the delivery. We assume that customers are heterogeneous with respect to h_o such that $h_o \sim U[0,1]$. If customers opt for the in-store pickup option, they incur a hassle cost of $h_p x$ for visiting the store to pick up their order, where h_p is the hassle cost per unit distance and x is the distance between a customer's location and the offline partner's location. Since customers are uniformly distributed on the circumference of the circular city, we have $x \sim U[0,1/2]$.

We introduce customer heterogeneity solely through delivery-related hassle costs to capture differences in tolerance for waiting, shipping inconvenience, and store visit-related frictions–factors that are empirically salient and central to delivery-mode choice.

Online Retailer: When the online retailer fulfills an order via direct-delivery, she incurs a direct-delivery fulfillment cost of $c_o < p$ due to the logistics required to ship the order from her warehouse to the customer's doorstep. When the online retailer fulfills an order via the in-store pickup option, she incurs an in-store pickup fulfillment cost of c_p due to the logistics required to ship the order from her warehouse to the offline partner. Following the literature (Morganti et al. 2014), we assume that, compared to the direct-delivery fulfillment option, the online retailer can save on logistics costs with the in-store pickup fulfillment option by pooling multiple orders into a single delivery; that is, $c_p \leq c_o$. Without loss of generality, we assume a zero procurement cost.

Offline Partner: When the offline partner acts as an in-store pickup point, she incurs a handling cost c_s for each pickup order because she must temporarily store the order and assign staff to process in-store pickups[4]. Customers who visit the offline partner to pick up their orders can generate cross-selling opportunities for the offline partner. To capture this effect, following the cross-selling literature (Gao and Su 2017, Ertekin et al. 2022), we assume that the offline partner earns a profit r from customers who visit the offline partner to pick up their order.

3.2. Baseline Policy

Under the baseline policy, the online retailer does not form a partnership with the offline partner and consequently offers only the direct-delivery option to her customers. Under this benchmark scenario, the utility of purchasing with the direct-delivery option amounts to $u_o^B = v - p - h_o$, where the superscript B denotes the *baseline policy*. We let d_o^B denote the online retailer's endogenous demand from customers who opt for the direct-delivery option under the baseline policy. Then, the online retailer's profit under the baseline policy is given by (all demand derivations are detailed in E-Companion EC.2)

$$\pi_o^B = (p - c_o) d_o^B. \tag{1}$$

Since there is no partnership, the offline partner does not earn any profit from the online retailer's customers (i.e., $\pi_s^B = 0$) under the baseline policy.

[4] In practice, the handling cost c_s may decrease with pickup volume due to economies of scale or negotiated volume-based discounts. Although such cost reductions may affect the conditions under which pickup partnerships are feasible, they do not alter the fundamental trade-off that differentiates the partnership models.

3.3. Fixed Fee Policy

Under the fixed fee policy, the online retailer and the offline partner establish a pickup partnership such that the online retailer pays the offline partner a fixed fee α for each in-store pickup order. Subsequently, the online retailer offers both direct-delivery and in-store pickup options to her customers. Customers who opt for the direct-delivery option earn a utility $u_o^F = v - p - h_o$, where the superscript F denotes the *fixed fee policy*. Customers who opt for the in-store pickup option earn a utility $u_p^F = v - p - xh_p$.[5] We let d_o^F and d_s^F denote the online retailer's demand for the direct-delivery and in-store pickup options, respectively, under the fixed fee policy. Then, the online retailer's profit under this policy is

$$\pi_o^F(\alpha) = (p - c_o)d_o^F + (p - c_p - \alpha)d_s^F. \tag{2}$$

In turn, the offline partner's profit from the partnership under the fixed fee policy is equal to

$$\pi_s^F(\alpha) = (r + \alpha - c_s)d_s^F. \tag{3}$$

3.4. Coupon Policy

The coupon policy establishes a pickup partnership between the online retailer and offline partner under which the online retailer provides a coupon with monetary value β to customers who opt for the in-store pickup option. Customers can then redeem the coupon to receive a discount on any purchase made at the offline partner. The online retailer reimburses the offline partner the amount β for any redeemed coupon.

We assume that customers who opt for the in-store pickup option will make a purchase from the offline partner to redeem the coupon with probability θ.[6] Therefore, under this policy, customers who opt for the direct-delivery option earn a utility $u_o^C = v - p - h_o$, where the superscript C denotes the *coupon policy*. Customers who opt for the in-store pickup option earn a utility $u_p^C = v + \theta\beta - p - xh_p$. Consistent with the literature showing that customers increase purchase amounts when they have a coupon (Gupta 1988, Krishna and Shoemaker 1992, Gopalakrishnan and Park 2021, Bawa and Shoemaker 2004), we assume that when the coupon is redeemed, the offline partner's profit from the cross-selling opportunity increases by β (i.e., the profit due to cross-selling becomes

[5] An alternative consideration to model u_p^F would be that customers who opt for the in-store pickup option might gain an additional utility from making a purchase at the offline partner's store during their in-store pickup. We demonstrated in E-Companion EC.4.1 that our findings are robust to this alternative modeling.

[6] In E-Companion EC.6.2, we allow θ to increase with β, representing the assumption that customers are more likely to redeem more generous coupons. Our main findings remain robust under this extension.

$r + \beta$ with probability θ).[7] [8] We let d_o^C and d_s^C denote the online retailer's demand for the direct-delivery and in-store pickup options, respectively, under the coupon policy. Consequently, the online retailer's profit is equal to

$$\pi_o^C(\beta) = (p - c_o)d_o^C + (p - c_p - \theta\beta)d_s^C, \tag{4}$$

whereas the offline partner's profit amounts to

$$\pi_s^C(\beta) = (r + \theta\beta - c_s)d_s^C. \tag{5}$$

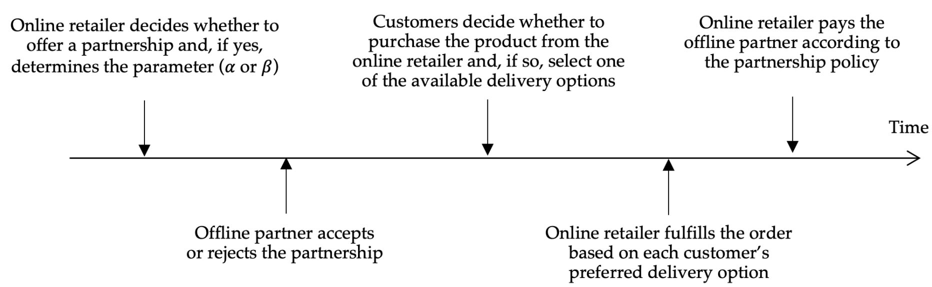


Figure 2 Timeline of Events

Under this modeling framework, the timeline of events shown in Figure 2 unfolds as follows:

1. The online retailer decides whether to form a pickup partnership with the offline partner, and if so, which policy to adopt. Under the fixed fee policy, the online retailer determines the optimal parameter α to maximize her profit $\pi_o^F(\alpha)$, subject to the offline partner's rationality constraint; that is, $\pi_s^F(\alpha) \geq 0$. Under the coupon policy, the online retailer determines the optimal coupon value β that maximizes her profit $\pi_o^C(\beta)$, subject to the offline partner's rationality constraint $\pi_s^C(\beta) \geq 0$.
2. The offline partner accepts or rejects the partnership.
3. Customers decide whether to purchase the product from the online retailer and, if so, select one of the available delivery options.
4. The online retailer fulfills the order based on each customer's preferred delivery option.
5. The online retailer pays the offline partner according to the partnership policy.

[7] Alternatively, one may assume that among customers who redeem the coupon, some make a purchase of $r + \beta$, while others use the coupon towards the purchase of r, implying the latter customers do not necessarily increase their purchase amounts due to the coupon. We demonstrate in E-Companion EC.4.2 that our findings are robust to this alternative assumption.

[8] In E-Companion EC.6.1, we relax the constant cross-selling benefit assumption and allow it to vary with the coupon value. We find that our qualitative insights from the main model remain unchanged.

Figure 3 illustrates the partnership policies considered by the online retailer as well as offline partner and the customer decision tree under each policy. Table 1 summarizes the customer utilities, online retailer's profit, and offline partner's profit under each policy. Table EC.1.1 in E-Companion EC.1 summarizes the notation used throughout the paper.

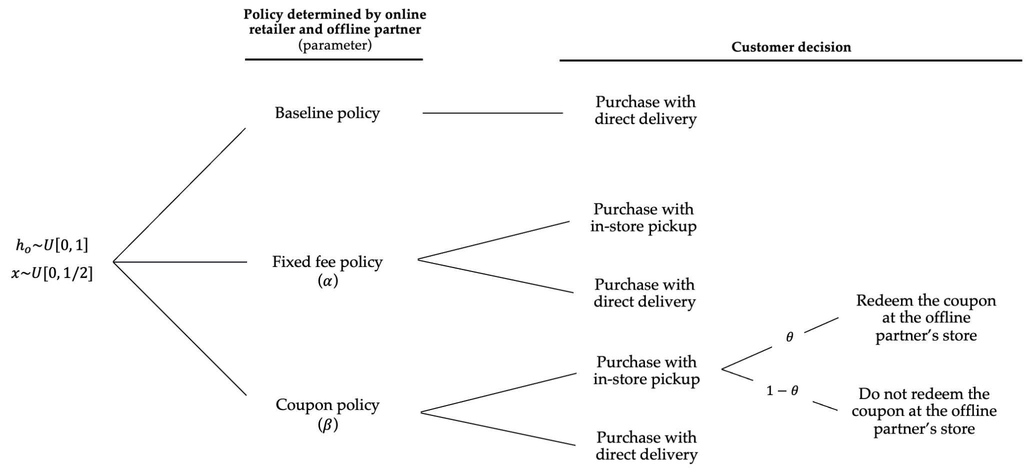


Figure 3 Partnership Policies and Customer Decision Trees

Table 1 Summary of Customer Utilities and Profit Functions

Policy	**Customer Utility**	**Online Retailer's Profit**	**Offline Partner's Profit**	d_o	d_s
Baseline	$u_o^B = v - p - h_o$	$(p-c_o)d_o^B$	0	$(v-p)/2$	–
Fixed fee	$u_o^F = v - p - h_o$ $u_p^F = v - p - xh_p$	$(p-c_o)d_o^F + (p-c_p-\alpha)d_s^F$	$(r+\alpha-c_s)d_s^F$	$\left(1-\frac{v-p}{h_p}\right)(v-p)$	$\frac{(v-p)(2-v+p)}{h_p}$
Coupon	$u_o^C = v - p - h_o$ $u_p^C = v - p - xh_p + \theta\beta$	$(p-c_o)d_o^C + (p-c_p-\theta\beta)d_s^C$	$(r+\theta\beta-c_s)d_s^C$	**1:** $\left(1-\frac{v-p+2\theta\beta}{h_p}\right)(v-p)$ **2:** $\frac{(h_p-2\theta\beta)^2}{4h_p}$ **3:** 0	$\frac{2\theta\beta+(2-v+p)(v-p)}{h_p}$ $1-\frac{(h_p-2\theta\beta)^2}{4h_p}$ 1

Coupon policy cases: **1:** $0 \le \beta \le \dfrac{h_p - 2(v-p)}{2\theta}$; **2:** $\dfrac{h_p - 2(v-p)}{2\theta} \le \beta \le \dfrac{h_p}{2\theta}$; **3:** $\beta \ge \dfrac{h_p}{2\theta}$.

4. Results

In this section, we first assess the feasibility and potential benefits of the fixed fee and coupon policies by comparing each policy to the baseline policy. We then compare all three policies to identify the most preferred policy for both the online retailer and the offline partner. Finally, we examine whether a given policy is suitable for certain types of online retailers as characterized by the various model parameters.

4.1. Fixed Fee Policy

We start by comparing the fixed fee policy with the baseline policy. We let Δd_o^i, Δd_s^i, and Δd^i denote the differences in direct-delivery demand, in-store pickup demand, and total demand, respectively, between a pickup partnership policy, where $i \in \{F, C\}$, and the baseline policy. We thus have $\Delta d^i = \Delta d_o^i + \Delta d_s^i$. We derive analytical expressions for Δd_o^F, Δd_s^F, and Δd^F in the following proposition (the proofs of all propositions are presented in E-Companion EC.3).

PROPOSITION 1. *Compared to the baseline policy, the fixed fee policy affects direct-delivery demand, in-store pickup demand, and total demand by*

$$\Delta d_o^F = -\underbrace{\frac{(v-p)^2}{h_p}}_{\substack{\text{Demand shift due to}\\ \text{convenience}}}$$

$$\Delta d_s^F = \underbrace{\frac{2(v-p)(1-v+p)}{h_p}}_{\substack{\text{Market expansion due to}\\ \text{convenience}}} + \underbrace{\frac{(v-p)^2}{h_p}}_{\substack{\text{Demand shift due to}\\ \text{convenience}}}$$

$$\Delta d^F = \underbrace{\frac{2(v-p)(1-v+p)}{h_p}}_{\substack{\text{Market expansion due to}\\ \text{convenience}}}$$

Proposition 1 reveals that the fixed fee policy induces two effects on the online retailer's demand relative to the baseline policy. First, some customers who were not purchasing under the baseline policy (due to the inconvenience caused by its high direct-delivery hassle cost) will now make a purchase via the in-store pickup option under the fixed fee policy. Specifically, these customers find visiting the offline partner's store to pick up their order more convenient due to the lower hassle cost. We call this effect the *market expansion effect* induced by the fixed fee policy. Second, due to the convenience of in-store pickups, some existing customers under the baseline policy will now choose this option. We call this effect the *demand shift effect* induced by the fixed fee policy. As a result, the fixed fee policy decreases direct-delivery demand due to its demand shift effect and creates a new demand stream through in-store pickups due to its market expansion and demand shift effects. Subsequently, the total demand increases only due to the market expansion effect since the demand shift effect simply transfers the existing demand from the direct-delivery option to the in-store pickup option.

A natural question that arises is how these demand changes affect the online retailer's and offline partner's profits, and whether it is beneficial to establish a pickup partnership under the fixed fee policy. We formally answer this question in Proposition 2. We let $\Delta\pi_o^i(\alpha)$ and $\Delta\pi_s^i(\alpha)$ denote the profit differences for the online retailer and the offline partner, respectively, between a pickup partnership policy, where $i \in \{F, C\}$, and the baseline policy.

Proposition 2. *(a) Compared to the baseline policy, the fixed fee policy with α affects the online retailer's and offline partner's profits by*

$$\Delta\pi_o^F = \underbrace{\frac{2(v-p)(1-v+p)}{h_p}(p-c_p-\alpha)}_{\text{Increase due to market expansion}} + \underbrace{\frac{(v-p)^2}{h_p}(c_o-c_p-\alpha)}_{\text{Change due to demand shift}}$$

$$\Delta\pi_s^F = \underbrace{\frac{(v-p)(2-v+p)}{h_p}(r+\alpha-c_s)}_{\text{Change due to market expansion and demand shift}}$$

(b) It is beneficial for both parties to establish a pickup partnership under the fixed fee policy if and only if $\alpha \in [\underline{\alpha}, \bar{\alpha}]$, where $\underline{\alpha} = \max\{0, c_s - r\}$ and $\bar{\alpha} = p - c_p - \frac{v-p}{2-v+p}(p-c_o)$.

Proposition 2 shows that the two demand streams induced by the fixed fee policy are key to its profitability for both parties. For the online retailer, the market expansion effect induced by the fixed fee policy increases profit due to the additional margins obtained from the new customers. However, the impact of the demand shift effect on the profit is more intricate. When α is relatively small, the cost of direct-delivery (c_o) is higher than the cost of in-store pickup ($c_p + \alpha$). Subsequently, the demand shift effect results in another profit increase for the online retailer due to the additional margins obtained from existing customers who alter their delivery option when the pickup partnership is available. By contrast, a sufficiently high α will make the in-store pickup option more costly for the online retailer, so customers generating the demand shift effect will lower the profit. In that case, the gain from new customers will be sufficient to compensate the loss from existing customers so long as $\alpha \leq \bar{\alpha}$. Otherwise (i.e., when $\alpha > \bar{\alpha}$), the fixed fee policy will decrease the online retailer's profit. For the offline partner, the margin from each new or existing customer who opts for the in-store pickup option is equal to $r + \alpha - c_s$. When $\alpha \geq \underline{\alpha}$, this margin is positive, so that the fixed fee policy will benefit the offline partner. Otherwise (i.e., when $\alpha < \underline{\alpha}$), the offline partner will be worse off under the fixed fee policy. We note that even if there is no fixed fee compensation (i.e., $\alpha = 0$), the pickup partnership can still be beneficial for the offline partner when the profit from cross-selling purchases is high enough (i.e., $r > c_s$).

Proposition 2 also establishes that when the fixed fee falls within the range $[\underline{\alpha}, \bar{\alpha}]$, both parties benefit under the fixed fee policy, enabling a mutually beneficial partnership.[9] Otherwise, at least one party is worse off; hence, a pickup partnership will not be established under the fixed fee policy. We note that as α increases, the online partner's profit decreases, while the offline partner's profit increases. Thus, the online retailer prefers the lowest feasible α (i.e., $\underline{\alpha}$), whereas the offline partner favors the highest (i.e., $\bar{\alpha}$). However, setting α at either extreme results in one party

[9] The word beneficial is used in a non-strict sense throughout the paper.

earning no profit. To avoid this situation and ensure a strictly beneficial outcome for both, the pickup partnership can be established by choosing a value of α such that $\underline{\alpha} < \alpha < \bar{\alpha}$. This win-win arrangement is tantamount to a revenue-sharing contract between a supplier and a retailer in supply chain management (Cachon and Lariviere 2005).

4.2. Coupon Policy

We compare the demand under the coupon and baseline policies in the following proposition.

PROPOSITION 3. *Compared to the baseline policy, the coupon policy affects direct-delivery demand, in-store pickup demand, and total demand by*

$$\Delta d_o^C = -\underbrace{\Big(\underbrace{\frac{(v-p)^2}{h_p}}_{\textit{due to convenience}} + \underbrace{\frac{(v-p)}{h_p}\hat{\beta}}_{\textit{due to promotion}}\Big)}_{\textit{Demand shift}}$$

$$\Delta d_s^C = \underbrace{\underbrace{\frac{2(v-p)(1-v+p)}{h_p}}_{\textit{due to convenience}} + \underbrace{\frac{(1-v+p)}{h_p}\hat{\hat{\beta}}}_{\textit{due to promotion}}}_{\textit{Market expansion}} + \underbrace{\underbrace{\frac{(v-p)^2}{h_p}}_{\textit{due to convenience}} + \underbrace{\frac{(v-p)}{h_p}\hat{\beta}}_{\textit{due to promotion}}}_{\textit{Demand shift}}$$

$$\Delta d^C = \underbrace{\underbrace{\frac{2(v-p)(1-v+p)}{h_p}}_{\textit{due to convenience}} + \underbrace{\frac{(1-v+p)}{h_p}\hat{\hat{\beta}}}_{\textit{due to promotion}}}_{\textit{Market expansion}}$$

where $\hat{\beta}$ and $\hat{\hat{\beta}}$ are increasing functions of β, as shown in E-Companion EC.3. Proposition 3 conveys that, similar to the fixed fee policy, the coupon policy induces both market expansion and demand shift effects, albeit with higher magnitudes. This is due to the fact that the coupon policy provides two levers to influence demand. First, as in the fixed fee policy, it attracts new customers and shifts some existing customers from direct-delivery to in-store pickup due to the increased convenience of the in-store pickup option. Second, unlike the fixed fee policy, the coupon policy induces additional new and existing customers who are incentivized by the monetary value of the coupon. In particular, some customers who were not purchasing under the fixed fee policy (despite its convenience) will now make a purchase under the coupon policy to take advantage of the discount they receive at the offline partner store when picking up their online order. Consequently, the coupon policy induces a greater market expansion effect relative to the fixed fee policy. Similarly, some existing customers who use the direct-delivery option under both the baseline and the fixed fee policies will opt for the in-store pickup option under the coupon policy to take advantage of the coupon at the offline partner, resulting in a greater demand shift effect compared to that under the fixed fee policy. Thus, the pickup partnership's effects on direct-delivery demand, in-store pickup demand, and total demand are greater under the coupon policy than under the fixed fee policy.

Proposition 4 characterizes the corresponding change in profit for both partners and the condition when it is beneficial to establish a pickup partnership under the coupon policy.

PROPOSITION 4. *(a) Compared to the baseline policy, the coupon policy affects the online retailer's and offline partner's profit by*

$$\Delta\pi_o^C = \underbrace{\left(\frac{2(v-p)(1-v+p)}{h_p} + \frac{(1-v+p)}{h_p}\hat{\hat{\beta}}\right)(p-c_p-\theta\beta)}_{\text{Increase due to market expansion}}$$

$$+ \underbrace{\left(\frac{(v-p)^2}{h_p} + \frac{(v-p)}{h_p}\hat{\beta}\right)(c_o-c_p-\theta\beta)}_{\text{Change due to demand shift}}$$

$$\Delta\pi_s^C = \underbrace{\left(\frac{(v-p)(2-v+p)}{h_p} + \frac{(1-v+p)}{h_p}\hat{\hat{\beta}} + \frac{(v-p)}{h_p}\hat{\beta}\right)(r+\theta\beta-c_s)}_{\text{Change due to market expansion and demand shift}}$$

(b) There exist two thresholds $\underline{\beta}$ and $\bar{\beta}$ such that it is beneficial for both parties to establish a pickup partnership under the coupon policy if and only if $\beta \in [\underline{\beta}, \bar{\beta}]$. Within this range, for the online retailer, the optimal coupon value is $\beta^* = \max\{\underline{\beta}, \check{\beta}\}$.

The closed-form expression for $\check{\beta}$ is reported in E-Companion EC.3. Proposition 4 shows that the profit implications of the demand change under the coupon policy are similar to those under the fixed fee policy. In short, the online retailer will be better off under the coupon policy so long as the additional profit margin earned from new customers induced by the market expansion effect offsets the loss from existing customers induced by the demand shift effect (i.e., when $\beta < \bar{\beta}$). Similarly, the offline partner will benefit from the partnership if she can collect a positive margin from customers who pick up their orders (i.e., when $\beta \geq \underline{\beta}$). Thus, when the monetary value of the coupon lies in $[\underline{\beta}, \bar{\beta}]$, no party is worse off under the coupon policy relative to the baseline policy. As in the fixed fee policy, the offline partner prefers the highest possible value of the coupon (i.e., $\bar{\beta}$) to maximize her profit under the coupon policy, which comes at the expense of a zero gain for the online retailer. However, unlike the fixed fee policy, the optimal coupon value for the online retailer is not necessarily the minimum feasible value (i.e., $\underline{\beta}$) under the coupon policy. The rationale is that although an increase in β will decrease the profit margin from an in-store pickup order for the online retailer, it may also lead to more customers (both new and existing) opting for the in-store pickup delivery option to take advantage of the higher discount β. If the net profit from these customers offsets the decrease in profit margin per in-store pickup order, then the optimal coupon value for the online retailer would be $\beta^* > \underline{\beta}$. Such a coupon also provides a strictly positive gain from the partnership for the offline partner, resulting in a win-win situation for the two parties. Otherwise, the optimal coupon value for the online retailer is $\beta^* = \underline{\beta}$, which makes the offline partner indifferent between the baseline and coupon policies. In that case, as with the fixed fee policy, a win-win pickup partnership under the coupon policy can be established with $\underline{\beta} < \beta < \bar{\beta}$.

4.3. Optimal Policy

Having characterized each pickup partnership in the previous subsections, we next compare all three policies to identify the optimal policy for both the online retailer and the offline partner. To do so, we first find the optimal solution for each policy and then compare the three optimal solutions to determine the best policy. To ensure that the two pickup partnership policies are compared objectively–and to capture the online retailer's practical dilemma of whether to allocate a given pickup facilitation budget to the offline partner or to customers–, we impose the constraint that the average compensation per in-store pickup order is the same under both policies (i.e., $\alpha = \theta\beta$).[10] Proposition 5 characterizes the results of this analysis conditional on c_s. We condition the analysis on c_s because it represents the offline partner's operational cost related to the partnership. Therefore, given that the process to establish a partnership starts with the online retailer selecting a partnership policy, the proposition conditioned on c_s can enable the online retailer to make that choice based on the offline partner's operational characteristics. We examine the sensitivity of the optimal policy with respect to other parameters in Section 4.4.

PROPOSITION 5. *There exist two thresholds $\underline{c}_s$ and $\bar{c}_s$ such that it is optimal for the online retailer and the offline partner*

- *not to establish a pickup partnership when $c_s > \bar{c}_s$,*
- *to establish a pickup partnership under the fixed fee policy with parameter $\alpha \in [c_s - r, \bar{c}_s - r]$ when $\underline{c}_s < c_s \leq \bar{c}_s$, and*
- *to establish a pickup partnership under the coupon policy with parameter $\beta \in [\max\{0, \frac{c_s - r}{\theta}\}, \frac{\underline{c}_s - r}{\theta}]$ when $c_s \leq \underline{c}_s$.*

The rationale behind Proposition 5 is as follows. When the offline partner's in-store pickup handling cost is high (i.e., $c_s > \bar{c}_s$), she finds the partnership beneficial only if the compensation for each in-store pickup order (i.e., α or β) is sufficiently high. However, such a high compensation makes the online retailer worse off with any pickup partnership (as we show in Figure 4, when $c_s > \bar{c}_s$, the online retailer is better off under the baseline policy). Therefore, a beneficial partnership does not exist, making the baseline policy the best option.

When a beneficial partnership exists (i.e., $c_s \leq \bar{c}_s$), the optimal policy is determined by the additional customers (both new and existing) who opt for the in-store pickup delivery option only under the coupon policy (i.e., customers forming the "market expansion due to promotion" and "demand shift due to promotion" segments shown in Proposition 3). When the in-store pickup handling cost is moderate (i.e., $\underline{c}_s < c_s \leq \bar{c}_s$), a beneficial partnership (under both fixed fee and

[10] We show in E-Companion EC.4.3 that our results are robust to comparing the two pickup partnership policies under their respective optimal policy parameters (i.e., $\alpha^*, \theta\beta^*$), which are allowed to differ.

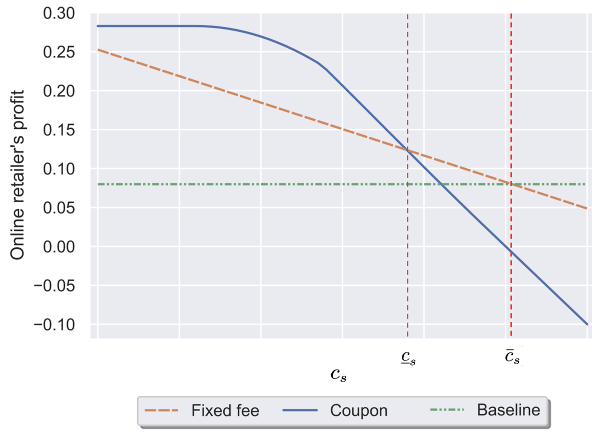


Figure 4 The Online Retailer's Profit under the Fixed Fee, Coupon, and Baseline Policies.

coupon policies) can be established only with a moderately high compensation (β or α). In this case, the coupon policy increases the profit by boosting the demand relative to the fixed fee policy. However, a moderately high compensation makes the in-store pickup fulfillment more costly (and thus less profitable) than direct-delivery fulfillment for the online retailer. Therefore, the coupon policy also decreases the profit by making more existing customers who would choose the direct-delivery option under the fixed fee policy switch to the more costly in-store pickup option. When the coupon value is moderately high, the increase in profit due to the demand boost effect cannot offset the loss due to the demand shift effect. As a result, the online retailer is worse off under the coupon policy with a moderately high β than under the fixed fee policy with an economically equivalent compensation (i.e., a moderately high α), making the fixed fee policy optimal. This can be seen in Figure 4.[11], which shows that the online retailer's profit is higher under the fixed fee policy when $\underline{c}_s < c_s \le \bar{c}_s$.

Finally, when the in-store pickup handling cost is low (i.e., $c_s \le \underline{c}_s$), a beneficial partnership under both fixed fee and coupon policies can be established with low compensation. In this case, the net profit from the additional new and existing customers induced by the coupon policy with a low β makes the online retailer better off relative to the fixed fee policy. Thus, the coupon policy is optimal when $c_s \le \underline{c}_s$.

4.4. Comparative Statics

In this section, we investigate whether a given optimal policy is more suitable for certain types of online retailers that can be characterized based on three key model parameters; namely c_o, c_p, and p. To do so, we examine the sensitivity of the optimal policy with respect to c_o, c_p, and p. All technical details related to this analysis are provided in E-Companion EC.5.

[11] The parameter values used in this figure are as follows: $p = 0.8$, $v = 1$, $c_p = 0.3$, $c_o = c_p + 0.1$, $h_p = 0.95$, $\theta = 1$.

We make three main observations. First, we find that the benefit of the pickup partnership increases as the direct-delivery fulfillment cost (c_o) increases and the in-store pickup fulfillment cost (c_p) decreases. Under a high c_o and a low c_p, the direct-delivery becomes a more costly (and less profitable) fulfillment method for the online retailer relative to the in-store pickup delivery. Consequently, the online retailer will earn a higher profit with the pickup partnership (under either a fixed fee or a coupon policy) due to customers choosing the relatively less costly in-store pickup delivery option. Second, between the two partnership policies, the coupon policy outperforms the fixed fee policy as c_o increases and c_p decreases. Since the coupon policy generates more in-store pickup demand than the fixed fee policy (as characterized by Proposition 3), the increasing benefit of the pickup partnership (as c_o increases and c_p decreases) becomes more pronounced under the coupon policy. Third, as the product price (p) increases, the coupon policy becomes more profitable than the fixed fee policy. An increase in p has two competing effects. While it increases the profit margin for both direct-delivery orders and in-store pickup orders, it also leads to lower demand for both types of orders. Since the coupon policy will generate a higher demand than the fixed fee policy (due to its promotional lever), the negative impact of the price increase on demand is more mitigated under the coupon policy.

Overall, as summarized in Table 2, these results suggest that a pickup partnership is not suitable for online retailers with low direct-delivery fulfillment cost (c_o) or high in-store pickup fulfillment cost (c_p) (e.g., online jewelry and luxury fashion retailers). The fixed fee policy is suitable for retailers with moderate direct-delivery cost, moderate in-store fulfillment cost, or low-priced products (e.g., online farmer marketplaces, online supermarkets), whereas the coupon policy is suitable for retailers with high direct-delivery cost, low in-store fulfillment cost, or high-priced products (e.g., meal kit companies, cosmetics retailers).

Table 2 Optimal Policy based on Online Retailer Characteristics

		$c_o(c_p)$		
		High (Low)	Moderate (Moderate)	Low (High)
p	High	Coupon	Coupon/Fixed fee	Baseline
	Low	Coupon/Fixed fee	Fixed fee	Baseline

5. Pickup Partnership with Hybrid Policy

An optimal partnership policy, as we identified in Proposition 5, aims to maximize the online retailer's profit subject to the offline partner's rationality constraint. Thus, to establish a pickup partnership, the online retailer has to offer either a fixed fee policy or a coupon policy while ensuring that the offline partner is not worse off relative to the baseline policy. In some situations, this may force the online retailer to select a partnership parameter that is not necessarily a profit maximizer for herself, implying that an optimal partnership policy can entail inefficiencies for the online retailer. Equivalently, we investigate when the offline partner's rationality constraint is tight. In this section, we first examine under which cases such inefficiencies exist for the two policies (fixed fee and coupon) used in current practices. We then prescribe a novel pickup partnership policy that alleviates such inefficiencies.

5.1. Inefficiency from Fixed Fee and Coupon Policies

We start by examining the optimal fixed fee policy. Recall from Proposition 5 that, when $\underline{c}_s < c_s \leq \bar{c}_s$, the online retailer prefers the fixed fee policy over the coupon policy with a moderately high β^*. Figure 5 illustrates the corresponding market segmentation under the optimal fixed fee policy. We observe that the optimal fixed fee policy with α generates a partial market coverage so that some customers (as depicted by the dotted region at the top-right corner in Figure 5) leave the market without making a purchase. Note that the online retailer can achieve the same market segmentation under the coupon policy by setting the coupon value to zero (i.e., $\beta = 0$). Consistent with Proposition 3, this implies that with any positive coupon value under a hypothetical coupon policy, the online retailer would generate additional sales from some of the customers in the dotted region, although a positive coupon value would also motivate some existing customers to change their delivery mode from direct-delivery to in-store pickup. As shown in Proposition 5, when the coupon value is low enough, the net profit change with any positive coupon value under that hypothetical coupon policy relative to the optimal fixed fee policy would be positive, representing an opportunity cost for the online retailer under the optimal fixed fee policy. When $\underline{c}_s < c_s \leq \bar{c}_s$, since the online retailer can encourage the offline partner to establish a partnership under the coupon policy using only a moderately high β^* (which makes the net profit change under the coupon policy compared to the optimal fixed fee policy negative), she prefers to establish the pickup partnership under a fixed fee policy despite its opportunity cost. Therefore, the aforementioned opportunity cost represents the inefficiency of the pickup partnership under the optimal fixed fee policy (relative to the hypothetical coupon policy with a low β).

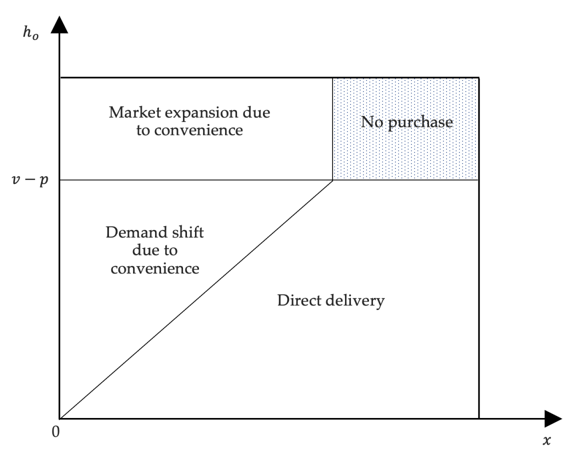


Figure 5 Market Segmentation under the Optimal Fixed Fee Policy

We next examine the optimal coupon policy. As discussed in Proposition 5, when $c_s \le \underline{c}_s$, the online retailer can induce the offline partner to establish a pickup partnership under the coupon policy with a relatively low β^*, making the coupon policy optimal. Figure 6 illustrates the corresponding market segmentation under the optimal coupon policy. We observe that the optimal coupon policy with β^* allows the online retailer to cover the entire market (i.e., all customers will make a purchase via direct-delivery or in-store pickup). However, as shown in Figure 6, β^* under the optimal coupon policy is greater than the minimum coupon value β_m under a hypothetical coupon policy that can allow the online retailer to just cover the entire market. This implies that the market expansion effect of the coupon policy is maximized when $\beta = \beta_m < \beta^*$. Thus, when the coupon value increases from β_m to β^*, the online retailer no longer generates new customers. Rather, as illustrated by the dotted region in Figure 6, an increase in the coupon value beyond β_m only induces more existing customers to change their delivery option from direct-delivery to in-store pickup. When the profit margin from an in-store pickup order is lower than the profit margin from a direct-delivery order, the customers in the dotted region will decrease the online retailer's profit relative to the profit under the hypothetical coupon policy with β_m. Despite this profit loss, when $c_s \le \underline{c}_s$, the online retailer constructs the optimal coupon policy with $\beta^* > \beta_m$, because any β lower than β^* will make the offline partner worse off under the partnership. Thus, in order to fairly compensate the offline partner under the optimal coupon policy, the online retailer will absorb the loss from the customers in the dotted region. Hence, the absorbed loss from these customers represents the inefficiency of the pickup partnership under the optimal coupon policy (relative to the hypothetical coupon policy with β_m).

Overall, we find that, despite being optimal, both the fixed fee and coupon policies may entail inefficiencies for the online retailer. In the next subsection, we prescribe an alternative partnership policy to alleviate such inefficiencies.

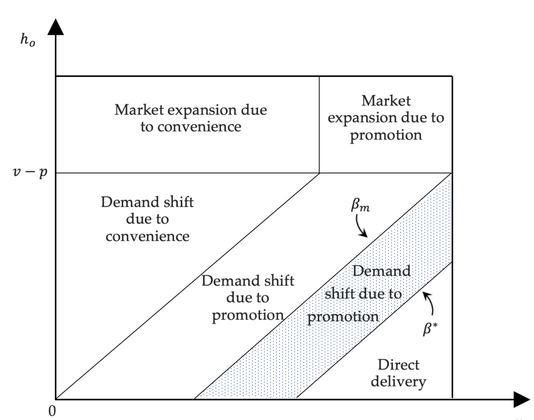


Figure 6 Market Segmentation under the Optimal Coupon Policy

5.2. Hybrid Policy

We show that an alternative partnership can be established such that for each in-store pickup, the online retailer can compensate the offline partner with a total compensation γ, of which α_h is paid to the offline partner as a fixed fee, and β_h (where $\beta_h = \frac{\gamma-\alpha_h}{\theta}$) is offered to the customers as a coupon. We term this policy the *hybrid policy*. We note that in this setting, the average compensation per in-store pickup order becomes equivalent to those under the fixed fee and coupon policies (i.e., $\gamma = \alpha = \theta\beta$).

Customer utilities for direct-delivery and in-store pickup options under the hybrid policy remain the same as under the coupon policy. We let d_o^H and d_p^H denote the online retailer's demand for direct-delivery and in-store pickup options, respectively, where the superscript H denotes the hybrid policy. Then, the online retailer's profit is equal to

$$\pi_o^H(\gamma) = (p - c_o)d_o^H + (p - c_p - \gamma)d_s^H, \tag{6}$$

whereas the offline partner's profit is equal to

$$\pi_s^H(\gamma) = (r + \gamma - c_s)d_s^H. \tag{7}$$

Proposition 6 characterizes how the optimal policy structure presented in Proposition 5 changes in the presence of the hybrid policy.

Proposition 6. *There exist thresholds $\bar{c}_p$, $\underline{\underline{c}}_s$, and $\bar{\bar{c}}_s$ such that*

(a) if $c_p < \bar{c}_p$, it is optimal for the online retailer and the offline partner

- *not to establish a pickup partnership when $c_s > \bar{c}_s$,*
- *to establish a pickup partnership under the fixed fee policy with parameter $\alpha \in [c_s - r, \bar{c}_s - r]$ when $\bar{\bar{c}}_s < c_s \leq \bar{c}_s$,*
- *to establish a pickup partnership under the hybrid policy with parameters $\beta_h = \beta_m$ and $\alpha_h \in [\max\{c_s - r - \theta\beta_m, 0\}, \bar{\bar{c}}_s - r - \theta\beta_m]$ when $\underline{\underline{c}}_s < c_s \leq \bar{\bar{c}}_s$, and*
- *to establish a pickup partnership under the coupon policy with parameter $\beta \in [\max\{0, \frac{c_s-r}{\theta}\}, \frac{\underline{\underline{c}}_s - r}{\theta}]$ when $c_s \leq \underline{\underline{c}}_s$.*

(b) otherwise (i.e., $c_p \geq \bar{c}_p$), the optimal policy structure from Proposition 5 remains the same.

The closed-form expressions for $\bar{c}_p$, $\underline{\underline{c}}_s$, and $\bar{\bar{c}}_s$ are provided in EC.3. Proposition 6 reveals that the hybrid policy can be a valuable lever for the online retailer to improve partnership efficacy only when the profit margin of the in-store pickup order is smaller than the profit margin of the direct-delivery order (i.e., $c_p < \bar{c}_p$ and $\underline{\underline{c}}_s < c_s \leq \bar{\bar{c}}_s$). In this case, the optimal policy structure characterized in Proposition 5 (labeled as "Without hybrid policy" in Figure 7) changes as shown by the "With

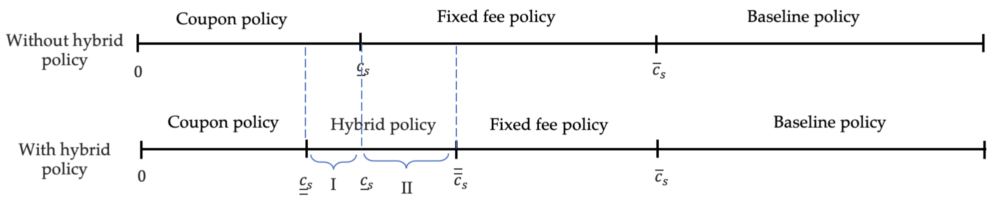


Figure 7 Optimal Policy with and without the Hybrid Policy

hybrid policy" case in Figure 7. The figure shows that the retailer is better off under the hybrid policy relative to the coupon policy in Region I and relative to the fixed fee policy in Region II. In Region I of Figure 7 (i.e., $\underline{\underline{c}}_s \leq c_s < \underline{c}_s$), in the absence of the hybrid policy, the online retailer establishes the partnership using the coupon policy with a relatively low β^* while absorbing the loss from the customers in the dotted region of Figure 6, as discussed in Section 5.1. The hybrid policy enables the online retailer to mitigate this loss. In particular, as illustrated in Figure 8, the online retailer will set the optimal hybrid policy coupon value β_h^* to β_m to cover the entire market, making the customers in Region A better off with the direct-delivery option and hence eliminating the loss from these customers. Since β_h^* is not high enough for the offline partner to accept the partnership, the online retailer will pay the remaining α_h of the hybrid policy compensation γ as a fixed fee to ensure that the offline partner is not worse off under the partnership. In Region II

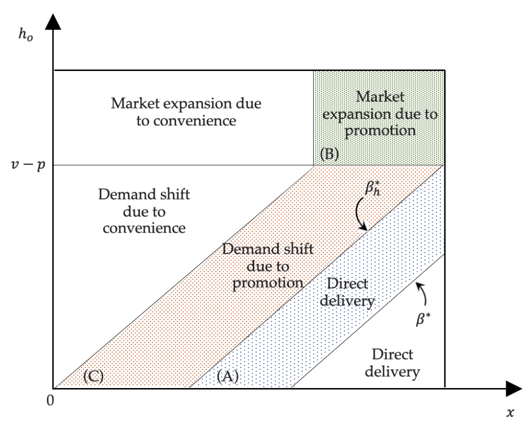


Figure 8 Market Segmentation under the Optimal Hybrid Policy

of Figure 7 (i.e., $\underline{c}_s \leq c_s < \bar{\bar{c}}_s$), in the absence of the hybrid policy, the online retailer establishes the partnership using the fixed fee policy, while missing the additional profit opportunity from customers who leave the market without making any purchase (i.e., customers in the blue dotted region in Figure 5), as discussed in Section 5.1. As illustrated in Figure 8, the hybrid policy enables the online retailer to attract those customers. In particular, by setting the optimal hybrid policy coupon value β_h^* to β_m, the online retailer will cover the entire market, including the customers in

Region B, thus generating an additional profit. However, this will also induce some of the existing customers (Region C in Figure 8) to change their preference from direct-delivery under the fixed fee policy to in-store pickup under the hybrid policy, generating an additional loss. Since β_h^* represents a low β, as implied by Proposition 5, the former's additional profit becomes greater than the latter's additional loss, ultimately making the online retailer better off under the hybrid policy.

We next conduct a numerical study to quantify the extent to which the hybrid policy can benefit the online retailer. Using a wide range of model parameters, our study results in 5,540 instances for which the partnership is beneficial to both parties under either the fixed fee or coupon policies.[12] We find that the hybrid policy can improve the online retailer's profit for 24.06% (1,333 of 5,540) of those instances. The average improvement in the online retailer's profit amounts to 5.14% (with a standard deviation of 3.13%), with minimum and maximum values of 0.78% and 14.45%.

To summarize, our proposed hybrid policy allows the online retailer to minimize the inefficiencies of the pickup partnership established under either the fixed fee or coupon policy while ensuring that the partnership remains beneficial for the offline partner. To our knowledge, such a hybrid policy has not yet been deployed in practice, potentially due to the fact that pickup partnerships are still in a fairly nascent stage. Nevertheless, our results suggest that online retailers should consider implementing a hybrid policy when establishing a pickup partnership, as it is likely to yield a more efficient partnership, especially when in-store pickup delivery fulfillment is costly.

6. Conclusion

To survive in the omnichannel era, many pure online retailers (e.g., Amazon, Cookit, Maturin) have recently started to form pickup partnerships with offline stores to provide their customers with convenient in-store pickup services. Despite this evolving business model, the literature on how to design and assess the impact of a pickup partnership is non-existent. To our knowledge, this paper is the first to develop an analytical model to theoretically examine the benefits of implementing a pickup partnership. In particular, we first analyze the two policies, the fixed fee and the coupon policies, that practitioners use to form pickup partnerships. We then characterize whether and how online retailers should choose between these two policies. We also convey that despite being optimal, both policies entail inefficiencies leading to an opportunity cost for the online retailer. We then prescribe a new type of policy that mitigates such inefficiencies.

[12] The parameter values are specified as follows: $p \in [0.7, 0.95]$ with 0.05 increments, $c_o \in [0.05p, 0.25p, 0.5p, 0.75p, 0.95p]$, $c_p \in [c_o, 0.75c_o, 0.5c_o, 0.25c_o, 0]$, $h_p \in [0.45, 0.75]$ with 0.1 increments, and $c_s \in [0, 1]$ with 0.05 increments. The remaining parameters are fixed at $v = 1$, $r = 0$, and $\theta = 1$. These values are chosen to reflect economically meaningful variation, while avoiding degenerate cases (i.e., parameter combinations for which at least one policy is infeasible). Our qualitative results are not sensitive to the values of v and θ. An increase in r amplifies the benefits of the partnership by enhancing the offline partner's utility without negatively affecting the online retailer. After excluding instances that do not satisfy model assumptions, the numerical study yields 5,946 instances, of which, 5,540 (i.e., 93.17%) result in a mutually beneficial pickup partnership.

Our results indicate that the cost structures of the online retailer and offline partner determine whether the two parties should form a pickup partnership and if so, which policy they should use. Specifically, we find that the coupon policy is particularly suitable for offline partners that can manage the in-store pickup process efficiently (i.e., those with low in-store pickup handling cost) and online retailers with a high direct-delivery fulfillment cost, a low in-store pickup fulfillment cost, or high-priced products. In contrast, the fixed fee policy is suitable for offline partners with a moderate in-store pickup handling cost and online retailers with a moderate direct-delivery fulfillment cost, a moderate in-store fulfillment cost, or low-priced products. We also find that the partnership will not be beneficial for offline partners with a high in-store pickup handling cost or for online retailers with a low direct-delivery fulfillment cost or a high in-store fulfillment cost.

We later extend our model to examine the pickup partnership under three different scenarios. First, we find that the presence of a budget constraint may reduce the online retailer's willingness to adopt a coupon policy, making the fixed fee policy a more suitable option for online retailers with limited budgets. Second, we consider an offline partner with multiple pickup locations and find that a larger number of pickup locations does not necessarily yield a higher profit for the partnership, especially when in-store pickup fulfillment is more costly than direct-delivery fulfillment. Third, we consider an online retailer maximizing total welfare for all parties (including customers) and find that the coupon policy always outperforms the fixed fee policy due to the additional utility earned by customers from the discounted coupons.

Finally, we find that both policies entail inefficiencies due to the misaligned incentives of the online retailer. More precisely, to ensure that the offline partner is not worse off with the partnership (relative to no partnership), in some cases the online retailer has to propose a partnership that does not necessarily maximize her own profit. In such cases, the online retailer cannot fully leverage the potential of the partnership. To address this issue, we propose a hybrid policy that allows the online retailer to split the compensation amount per in-store pickup order between the offline partner (in the form of a fixed fee) and customers (in the form of a coupon). We then show that our proposed hybrid policy allows the online retailer to minimize these inefficiencies, while ensuring that the pickup partnership remains attractive for the offline partner. In a numerical study, we find that such inefficient partnerships can be common and that the profit improvement generated by the hybrid policy is substantial.

Our results provide several managerial implications for retailers seeking to establish a pickup partnership. First, a newly established partnership may require a fixed investment cost for the offline partner (e.g., setting up a pickup point in the store, assigning staff to process pickups) and the volume of in-store pickup orders is likely to increase over time as customers become more familiar with this service. Thus, the offline partner's handling cost is likely to be high in a newly established partnership. However, it will likely decline over time as the volume of in-store pickup orders increases and the offline partner improves the process through learning-by-doing. Therefore, a direct implication of our study is that a pickup partnership should initially be established using the fixed fee policy. As the offline partner becomes more efficient in processing in-store pickup orders, both parties can be better off by switching from the fixed fee policy to the coupon policy. In fact, our glance at the current pickup partnerships in the industry reveals an observation consistent with our implication. We observe that at this nascent stage of pickup partnerships, as implied by our study, firms mostly prefer the fixed fee policy relative to the coupon policy. Second, our results suggest that the parties are better off by customizing the partnership not only based on the stage of their relationship but also on the specific characteristics of the business setting. For example, for low-priced staple items, the fixed fee policy is more beneficial, whereas for high-priced niche items, the coupon policy is better. Since the hybrid policy encompasses both the fixed fee and coupon policies, it allows the online retailer to be more flexible in the partnership implementation. Third, although our results show that the optimal parameters for both the fixed fee and coupon policies depend on the characteristics of the business setting, we believe that the coupon policy may be an easier-to-implement option. For example, under the fixed fee policy, if the online retailer wants to set a fee that depends on the product price, both the online and offline partners need to keep track of actual transactions to determine the total transfer amount owing to the pickup partnership. Under the coupon policy, however, the online retailer can easily set a different coupon value based on the product price and make a transfer to the offline partner based on the redeemed amount.

While our study sheds light on pickup partnerships, further research is needed to better understand this growing practice. Several promising avenues emerge. First, future work could examine how partnership policies influence the operational decisions of online retailers and offline partners, such as assortment, pricing, and inventory choices. Second, empirical studies could investigate the short- and long-term effects of different partnership policies on both parties, including demand dynamics, customer retention, and profitability. Third, our study focuses on pickup partnership models with uniform, demand-independent compensation (i.e., α, β). In practice, similar to quantity discount contracts, online retailers and offline partners may adopt pickup partnerships in which compensation depends on pickup volume. Examining the design and coordination of pickup partnerships with quantity-dependent compensation is therefore a natural avenue for future research. Finally, we do not consider competition between online retailers and offline partners. Incorporating competitive interactions would be a valuable extension, as competition may jointly shape bargaining power, contract terms, and the incentives underlying pickup partnership strategies.

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E-Companion for Offline-Online Retail Collaboration via Pickup Partnership

EC.1. Tables and Figures

Table EC.1.1 Summary of Notation

Symbol	Definition
	Notation related to the customer
v	Customer's valuation for the product
h_o	Customer's hassle cost of using the direct-delivery option (e.g., shipping cost and delivery time)
x	Distance between customer's location and pickup location
h_p	Customer's hassle cost per unit of distance to visit the pickup location
θ	Probability that the customer redeems the coupon at the offline partner's store when picking up the order
r	Offline retailer's cross-selling profit per customer who picks up the order in-store
p	Price of the product
	Notation related to the online retailer
c_o	Online retailer's handling cost for each direct-delivery order (e.g., direct shipping cost)
c_p	Online retailer's handling cost for each in-store pickup order (e.g., cost of shipping to the pickup location)
α	Compensation value paid by the online retailer to the offline partner for each in-store pickup order
β	Monetary value of the coupon offered by the online retailer to be redeemed at the pickup location
d_o^i	Online retailer's expected demand for direct-delivery orders under policy $i \in \{F, C\}$
d_s^i	Online retailer's expected demand for in-store pickup orders under policy $i \in \{F, C\}$
π_o^i	Online retailer's expected profit under policy $i \in \{F, C\}$
	Notation related to the offline partner
c_s	Offline partner's handling cost per in-store pickup order (e.g., staff and storage)
π_s^i	Offline partner's expected profit from the partnership under policy $i \in \{F, C\}$

EC.2. Demand Functions

To avoid trivial cases, in all appendices, we assume that under the baseline and fixed fee policies, there are some customers who leave the market, that is, $v - p < 1$ and $(v - p)/h_p < 1/2$. At the end of this section, we will explain the results if these two assumptions are relaxed.

EC.2.1. Baseline Policy

Under the baseline policy, based on their utility, customers can either purchase the product via direct-delivery or leave the market. Since the customer's utility from leaving the market is zero, a customer will purchase the product if her utility from buying is positive. Thus, since $h_o \sim U[0,1]$ and $x \sim U[0,1/2]$, the online retailer's demand under the baseline policy is simply $d_o^B = v - p$.

EC.2.2. Fixed Fee Policy

Under the fixed fee policy, as shown in Figure EC.2.1 (b), customer decisions are as follows:

(a) When $h_o \leq \min\{v - p,\, xh_p\}$, the customer purchases via direct delivery.

(b) When $x \leq \min\left\{\frac{h_o}{h_p},\, \frac{v-p}{h_p}\right\}$, the customer purchases via in-store pickup.

(c) When $v - p < \min\{h_o,\, xh_p\}$, the customer leaves the market.

Therefore, the demands for direct delivery and in-store pickup (equivalent to the area under each pickup option in Figure EC.2.1(b)) are given by (note that $h_0 \in [0,1]$ and $x \in [0,1/2]$):

$$d_s^F = \frac{(v-p)(2-v+p)}{h_p} \quad \text{and} \quad d_o^F = \left[1 - \frac{(v-p)}{h_p}\right](v-p).$$

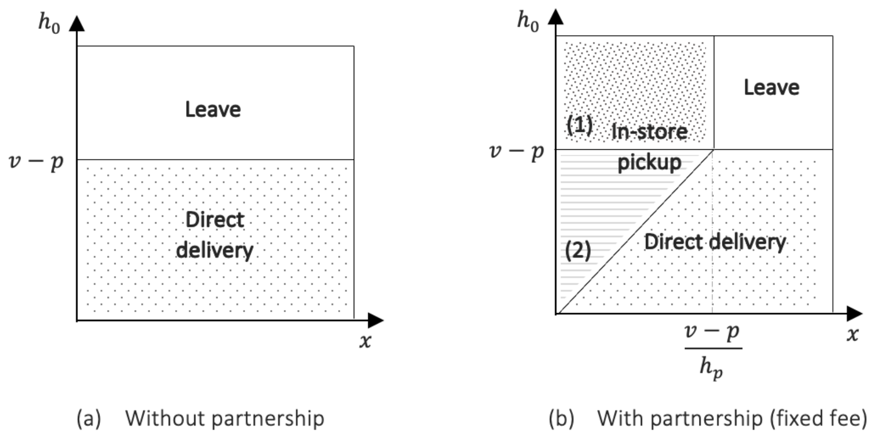


Figure EC.2.1 Market Segmentation with and without Pickup Partnership under Fixed Fee Policy

EC.2.3. Coupon Policy

Under the coupon policy, customer decisions are as follows (as shown in Figure X):

a. When $h_o \leq \min\{v-p, xh_p - \theta\beta\}$, the customer purchases via direct-delivery.

b. When $x \leq \min\{\frac{h_o+\theta\beta}{h_p}, \frac{v-p+\theta\beta}{h_p}\}$, the customer purchases via in-store pickup.

c. When $v-p < \min\{h_o, xh_p - \theta\beta\}$, the customer leaves the market.

Therefore, the demand for the direct-delivery and in-store pickup options are given by:

$$d_s^C = \begin{cases} \frac{2\theta\beta+(2-v+p)(v-p)}{h_p}, & 0 \leq \beta \leq \frac{h_p-2(v-p)}{2\theta} \\ (1-\frac{(h_p-2\theta\beta)^2}{4h_p}) & \frac{h_p-2(v-p)}{2\theta} \leq \beta \leq \frac{h_p}{2\theta} \\ 1 & \beta \geq \frac{h_p}{2\theta} \end{cases} \quad \text{and} \quad d_o^C = \begin{cases} (1-\frac{(v-p+2\theta\beta)}{h_p})(v-p), & 0 \leq \beta \leq \frac{h_p-2(v-p)}{2\theta} \\ \frac{(h_p-2\theta\beta)^2}{4h_p}, & \frac{h_p-2(v-p)}{2\theta} \leq \beta \leq \frac{h_p}{2\theta} \\ 0, & \beta \geq \frac{h_p}{2\theta} \end{cases}$$

Similarly, we can calculate demand for each range of β by computing the area corresponding to each pickup option in Figure EC.2.2.

EC.3. Proofs of Statements

Proof of Proposition 1. The proof of Proposition 1 follows directly from the demand function derived in Appendix EC.2. □

Proof of Proposition 2. (a) For the online retailer, we have

$$\Delta\pi_o^F = (p-c_o)\Delta d_o^B + (p-c_p-\alpha)\Delta d_s^F \implies \Delta\pi_o^F = \frac{2(v-p)(1-v+p)}{h_p}(p-c_p-\alpha) + \frac{(v-p)^2}{h_p}(c_o-c_p-\alpha),$$

and for the offline partner, we have

$$\Delta\pi_s^F = (r+\alpha-c_s)\Delta d_s^F = \frac{(v-p)(2-v+p)}{h_p}(r+\alpha-c_s).$$

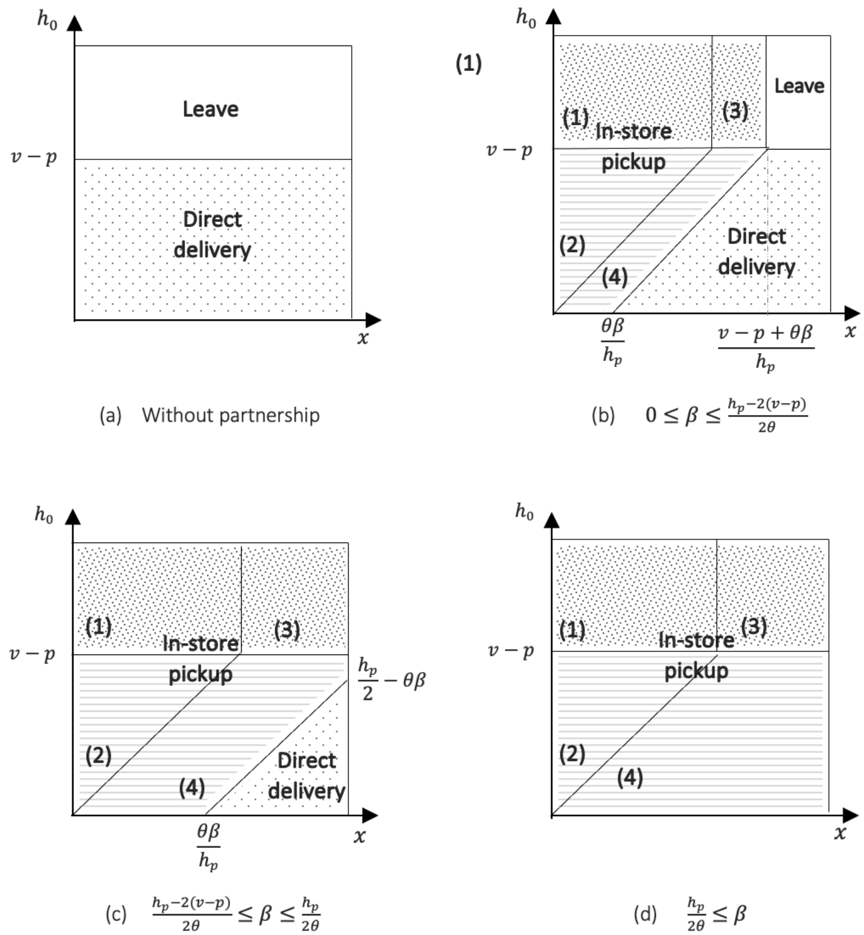


Figure EC.2.2 Market Segmentation with and without Pickup Partnership under Coupon Program Policy

(b) The offline partner will accept the pickup partnership offer if and only if $\Delta\pi_s^F \ge 0$. Since $\Delta d_s^F > 0$ and $\alpha \ge 0$, $\Delta\pi_s^F$ is positive if

$$r+\alpha-c_s \ge 0 \implies \alpha \ge \max\{0, c_s-r\} = \underline{\alpha}.$$

Similarly, the online retailer will initiate the partnership under the fixed fee policy if and only if $\Delta\pi_o^F \ge 0$, and thus

$$\Delta\pi_o^F = \frac{2(v-p)(1-v+p)}{h_p}(p-c_p-\alpha)+\frac{(v-p)^2}{h_p}(c_o-c_p-\alpha) \ge 0 \implies \alpha \le p-c_p-\frac{v-p}{2-v+p}(p-c_o) = \bar{\alpha}.$$

Therefore, the partnership under the fixed fee policy is beneficial only when $\alpha \in [\underline{\alpha}, \bar{\alpha}]$. □

Proof of Proposition 3. The proof of Proposition 3 directly follows from the demand functions derived in Appendix EC.2. We note that $\hat{\beta}$ and $\hat{\hat{\beta}}$ are given by:

$$\hat{\beta} = \begin{cases} 2\theta\beta & 0 \le \beta \le \frac{h_p-2(v-p)}{2\theta} \\ \frac{4\theta\beta(hp+\theta\beta)-h_p^2}{v-p}+h_p-v+p & \frac{h_p-2(v-p)}{2\theta} \le \beta \le \frac{h_p}{2\theta} \\ (h_p-v+p) & \beta \ge \frac{h_p}{2\theta} \end{cases} \quad \text{and} \quad \hat{\hat{\beta}} = \begin{cases} 2\theta\beta & 0 \le \beta \le \frac{h_p-2(v-p)}{2\theta} \\ \frac{(h_p-2v+2p)}{2} & \beta \ge \frac{h_p-2(v-p)}{2\theta} \end{cases} \quad \square$$

Proof of Proposition 4. (a) This result can be shown by substituting the demand function into the profit function reported in Section 3.

(b) The existence proof of $\underline{\beta}$ follows a similar argument to that of $\underline{\alpha}$. Thus, we only show the existence of $\bar{\beta}$, and we can then find β^*. To show the existence of $\bar{\beta}$, it is enough to show that $\pi_o^C(\beta)$ is a continuous and unimodal function of β (i.e., there exists a $\check{\beta}$ such that $\pi_o^C(\beta)$ is increasing for $\beta<\check{\beta}$ and decreasing for $\beta\geq\check{\beta}$) and that $\pi_o^B\leq\pi_o^C(\beta=0)$.

One can easily show that $\pi_o^B<\pi_o^C(0)$ and that $\pi_o^C(\beta)$ is a continuous function. Thus, we only need to show that $\pi_o^C(\beta)$ is a unimodal function of β. The online retailer's profit under the coupon policy can be written as the following piece-wise function of β:

$$\pi_o^C(\beta)=\begin{cases}(1-\frac{2\theta\beta+v-p}{h_p})(v-p)(p-c_o)+\frac{2\theta\beta+(2-v+p)(v-p)}{h_p}(p-c_p-\theta\beta), & 0\leq\beta\leq\frac{h_p-2(v-p)}{2\theta}\\ \frac{(h_p-2\theta\beta)^2}{4h_p}(p-c_o)+(1-\frac{(h_p-2\beta)^2}{4h_p})(p-c_p-\theta\beta), & \frac{h_p-2(v-p)}{2\theta}\leq\beta\leq\frac{h_p}{2\theta}\\ (p-c_p-\theta\beta) & \beta\geq\frac{h_p}{2\theta}\end{cases} \tag{EC.3.1}$$

The first term in $\pi_o^C(\beta)$ is a quadratic function of β, which is denoted by $A(\beta)$. We thus have

$$\frac{\partial A(\beta)}{\partial\beta}=\frac{2\theta}{h_p}\Big[p-c_p-(v-p)(p-c_o)-\frac{(2-v+p)(v-p)}{2}-2\theta\beta\Big].$$

The root of $\frac{\partial A(\beta)}{\partial\beta}$ is given by:

$$\beta_A^*=\frac{p-c_p}{2\theta}-\frac{(v-p)(p-c_o)}{2\theta}-\frac{(2-v+p)(v-p)}{4\theta}.$$

This root maximizes $A(\beta)$ if $0\leq\beta_A^*\leq\frac{h_p-2(v-p)}{2\theta}$. In other words, β_A^* maximizes $A(\beta)$ if

$$(v-p)c_o+(1-v+p)p+\frac{(2+v-p)(v-p))}{2}-h_p\leq c_p\leq(v-p)c_o+(1-v+p)p-\frac{(v-p)(2-v+p)}{2}.$$

If $c_p>(v-p)c_o+(1-v+p)p-\frac{(v-p)(2-v+p)}{2}$, then $\beta_A^*<0$, meaning that $A(\beta)$ is decreasing in β for $0\leq\beta\leq\frac{h_p-2(v-p)}{2}$. If $c_p<(v-p)c_o+(1-v+p)p+\frac{(2+v-p)(v-p))}{2}-h_p$, then $\beta_A^*>\frac{h_p-2(v-p)}{2\theta}$, meaning that $A(\beta)$ is increasing in β for $0\leq\beta\leq\frac{h_p-2(v-p)}{2\theta}$.

The second term in $\pi_o^C(\beta)$ is a cubic function of β, which is denoted by $B(\beta)$ and can be written as follows:

$$\begin{aligned}B(\beta)&=(p-c_p-\theta\beta)+\frac{h_p^2+4(\theta\beta)^2-4h_p\theta\beta}{4h_p}(c_p+\theta\beta-c_o)\\ &=\frac{1}{h_p}(\theta\beta)^3+\frac{c_p-c_o-h_p}{h_p}(\theta\beta)^2+(c_o-c_p-1+\frac{h_p}{4})\theta\beta+(\frac{h_p}{4}(c_p-c_o)+p-c_p).\end{aligned}$$

Since $\frac{\theta^3}{h_p}>0$, Figure EC.3.1(a) depicts the only possible pattern for $B(\beta)$.

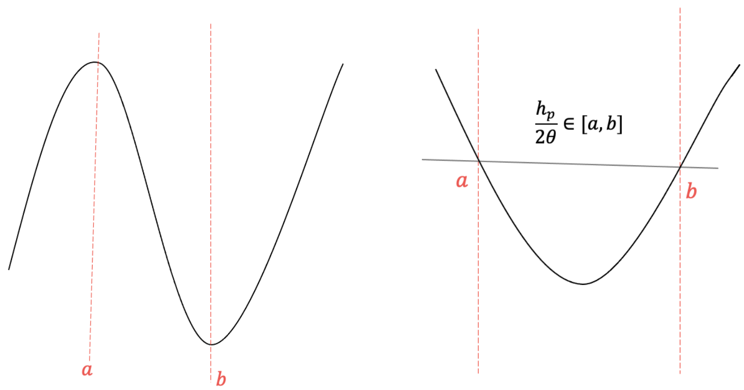
The first derivative of $B(\beta)$ is given by:

$$\frac{\partial B(\beta)}{\partial\beta}=-\theta+\frac{h_p-2\theta\beta}{h_p}\theta(c_o-c_p)-\frac{h_p-2\theta\beta}{h_p}\theta^2\beta+\frac{(h_p-2\theta\beta)^2}{4h_p}\theta,\quad \frac{h_p-2(v-p)}{2\theta}<\beta\leq\frac{h_p}{2\theta}.$$

When $\beta=\frac{h_p}{2\theta}$, we have $\frac{\partial B(\beta)}{\partial\beta}=-\theta<0$. Therefore, $\frac{h_p}{2\theta}\in[a,b]$, where a and b are the roots of $\frac{\partial B(\beta)}{\partial\beta}$ (see Figure EC.3.1).

When $\beta=\frac{h_p-2(v-p)}{2\theta}$, we have

$$\begin{aligned}\frac{\partial B(\beta)}{\partial\beta}&=\frac{2(v-p)}{h_p}\theta(c_o-c_p)-\frac{2(v-p)}{h_p}(\frac{h_p}{2}-v+p)\theta+\frac{(v-p)^2}{h_p}\theta-\theta\\ &=\Big[\frac{2(v-p)}{h_p}(c_o-c_p)-(v-p)+\frac{3(v-p)^2}{h_p}-1\Big]\theta.\end{aligned}$$



(a) Possible Pattern for $B(\beta)$ (b) Plot of $\frac{\partial B(\beta)}{\partial \beta}$

Figure EC.3.1

If $c_p \le c_o + \frac{3(v-p)}{2} - \frac{h_p}{2} - \frac{h_p}{2(v-p)}$, then $\frac{\partial B(\beta)}{\partial \beta} \ge 0$ for $\beta = \frac{h_p - 2(v-p)}{2\theta}$. It means that $\frac{h_p-2(v-p)}{2\theta} < a$, where a is the first root of $\frac{\partial B(\beta)}{\partial \beta}$ (see Figure EC.3.1). Therefore, when $c_p \le c_o + \frac{3(v-p)}{2} - \frac{h_p}{2} - \frac{h_p}{2(v-p)}$, a maximizes $B(\beta)$. Since $\frac{\partial B(\beta)}{\partial \beta}$ is a quadratic function of β, a is given by:

$$a = \frac{1}{6\theta}\Big[2(h_p + c_o - c_p) - \sqrt{(2c_p + h_p)^2 + 4c_o(c_o - h_p - 2c_p) + 12h_p}\Big].$$

When $c_p > c_o + \frac{3(v-p)}{2} - \frac{h_p}{2} - \frac{h_p}{2(v-p)}$, $\frac{\partial B(\beta)}{\partial \beta} < 0$ for $\beta = \frac{h_p-2(v-p)}{2\theta}$. Therefore, $\frac{h_p-2(v-p)}{2\theta} \in [a, b]$, where a and b are the roots of $\frac{\partial B(\beta)}{\partial \beta}$. Thus, $B(\beta)$ is decreasing in β when $\beta \in [\frac{h_p-2(v-p)}{2\theta}, \frac{h_p}{2\theta}]$ and $\beta = \frac{h_p-2(v-p)}{2\theta}$ maximizes $B(\beta)$.

The third term of $\pi_o^C(\beta)$ is a linear function of β, which is denoted by $C(\beta)$. Since $\frac{\partial C(\beta)}{\partial \beta} = -\theta < 0$, $C(\beta)$ is decreasing in β.

We define $c_1 = c_o - \frac{h_p}{2} - \frac{h_p}{2(v-p)} + \frac{3(v-p)}{2}$, $c_2 = (v-p)c_o + (1-v+p)p + \frac{(2+v-p)(v-p)}{2} - h_p$, and $c_3 = (v-p)c_o + (1-v+p)p - \frac{(v-p)(2-v+p)}{2}$. Since we assume that $v - p < 1$ and $\frac{v-p}{h_p} \le \frac{1}{2}$ (i.e., there are some customers who leave the market under the baseline and fixed fee policies), we can show that $c_3 \ge c_2 \ge c_1$. Since $\pi_o^C(\beta)$ is continuous, $\pi_o^C(\beta)$ can have only one of four possible patterns as shown in Figure EC.3.2. We thus conclude that $\pi_o^C(\beta)$ is a continuous and unimodal function.

Since $\pi_o^C(\beta)$ is a continuous and unimodal function, there exists a unique $\check{\beta}$ (see closed-form expression below) that maximizes $\pi_o^C(\beta)$.

$$\check{\beta} = \begin{cases} \frac{1}{6\theta}\Big[2(h_p + c_o - c_p) - \sqrt{(2c_p + h_p)^2 + 4c_o(c_o - h_p - 2c_p) + 12h_p}\Big], & c_p \le c_1 \\ \frac{1}{2\theta}\Big[h_p - 2(v-p)\Big], & c_1 < c_p \le c_2 \\ \frac{1}{4\theta}\Big[2(p - c_p) - 2(v-p)(p - c_o) - 2(v-p) + (v-p)^2\Big], & c_2 < c_p \le c_3 \\ 0, & c_p > c_3 \end{cases}$$

where $c_1 = c_o - \frac{h_p}{2} - \frac{h_p}{2(v-p)} + \frac{3(v-p)}{2}$, $c_2 = (v-p)c_o + (1-v+p)p + \frac{(2+v-p)(v-p)}{2} - h_p$, and $c_3 = (v-p)c_o + (1-v+p)p - \frac{(v-p)(2-v+p)}{2}$.

The variable $\check{\beta}$ maximizes the online retailer's profit under the coupon policy without considering the offline partner's rationality constraint. If $\beta = \check{\beta}$ does not satisfy the rationality constraint, then the online retailer should increase the value of β. Since $\pi_o^C(\beta)$ is decreasing for $\beta > \check{\beta}$, in that case, the optimal value is the smallest value that satisfies the offline partner's rationality constraint, that is, $\frac{c_s - r}{\theta}$. As a result, the optimal value of β is $\max\{\frac{c_s-r}{\theta}, \check{\beta}\}$. □

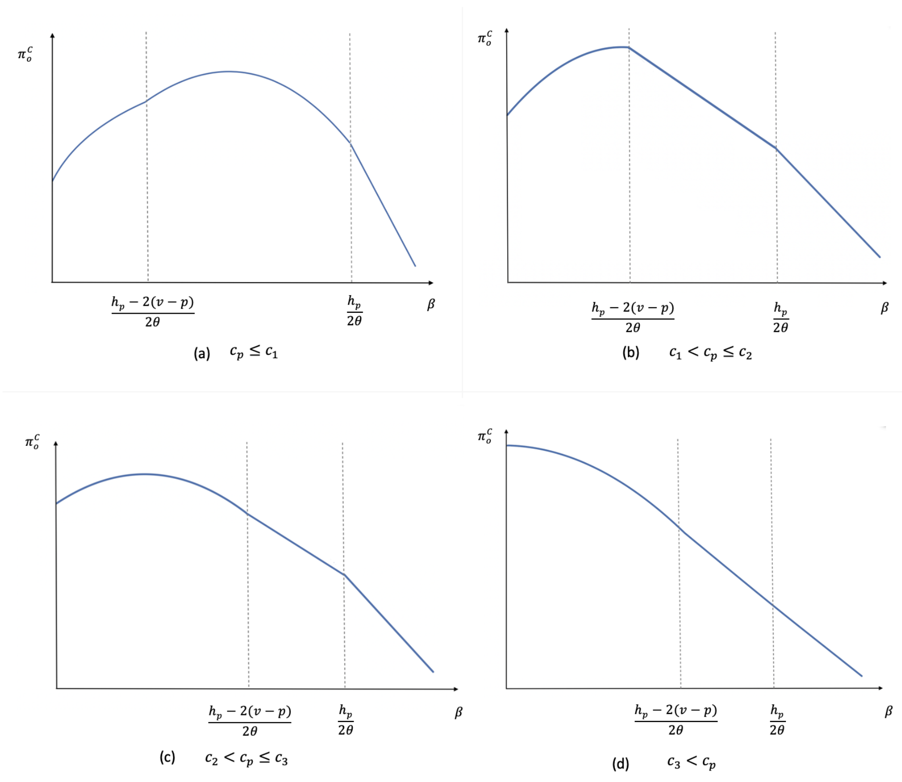


Figure EC.3.2 The Online Retailer's Profit under the Coupon Policy

Proof of Proposition 5. First, we show that there exists a unique $\bar{\bar{\beta}}$ such that under condition $\theta\beta = \alpha$, the online retailer will prefer the coupon policy over the fixed fee policy when $\beta \le \bar{\bar{\beta}}$ (i.e., for $\alpha = \theta\beta \le \theta\bar{\bar{\beta}}$, $\pi_o^F(\alpha) \le \pi_o^C(\beta)$). We also show that $\theta\bar{\bar{\beta}} \le \bar{\alpha}$ and $\bar{\bar{\beta}} < \bar{\beta}$. By combining these findings with Propositions 2 and 4, it is straightforward to show that the optimal policy is (i) the coupon policy when $c_s \le r + \theta\bar{\bar{\beta}} = \underline{c}_s$, (ii) the fixed fee policy when $r + \theta\bar{\bar{\beta}} = \underline{c}_s < c_s \le r + \bar{\alpha} = \bar{c}_s$, and (iii) the baseline policy when $c_s > \bar{c}_s$.

The existence of $\bar{\bar{\beta}}$ can be shown using the characteristics of $\pi_o^C(\beta)$ as discussed in the proof of Proposition 4. For $\frac{\alpha}{\theta} = \beta > \check{\beta}$, the online retailer's profit is decreasing in the partnership parameter under both the fixed fee and the coupon policies, and $|\frac{\partial \pi_o^C(\beta)}{\partial \beta}| > \theta |\frac{\partial \pi_o^F(\alpha)}{\partial \alpha}|$ for $\beta > \frac{h_p - 2(v-p)}{2\theta}$. Therefore, $\pi_o^C(\beta) = \pi_o^F(\alpha)$ has a unique solution.

Since $\pi_o^F(\alpha = 0) = \pi_o^C(\beta = 0)$, $\pi_o^C(\beta)$ is a unimodal function, and $\pi_o^F(\alpha)$ is a decreasing function of α, if we show that $\theta\bar{\beta} \le \bar{\alpha}$, then we can conclude that $\theta\bar{\bar{\beta}} < \bar{\alpha}$ (see Figure EC.3.3). To show this, it is enough to show that $\pi_o^C(\frac{\bar{\alpha}}{\theta}) < \pi_o^F(\bar{\alpha}) = \pi_o^B$ where $\bar{\alpha} = p - c_p - \frac{v-p}{2-v+p}(p - c_o)$. The following tree situations are then possible:

1. $\bar{\alpha} > \frac{h_p}{2}$. In this case, we have
$$\pi_o^C(\frac{\bar{\alpha}}{\theta}) = (p - c_p - \bar{\alpha}) = \frac{v-p}{2-v+p}(p-c_o) < (v-p)(p-c_o) = \pi_o^B,$$
where the last inequality follows from $v - p < 1$.

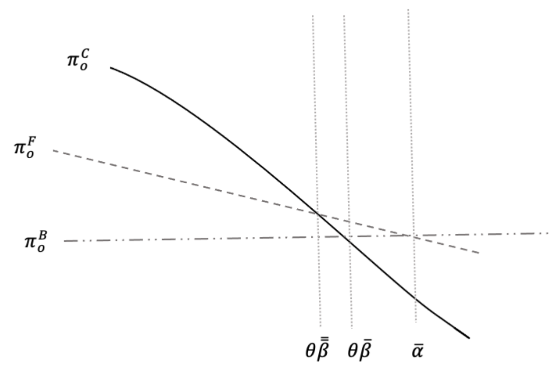


Figure EC.3.3 Possible Relationship Between $\bar{\bar{\beta}}$, $\bar{\beta}$, and $\bar{\alpha}$

2. $\frac{h_p-2(v-p)}{2} < \bar{\alpha} \le \frac{h_p}{2}$. In this case, we have

$$\pi_o^C(\frac{\bar{\alpha}}{\theta}) = \Big[p - c_p - \bar{\alpha} + (c_p + \bar{\alpha} - c_o)\frac{(h_p - 2\bar{\alpha})^2}{4h_p}\Big] = \Big[1 - \frac{(h_p-2\bar{\alpha})^2}{4h_p}\Big]\frac{v-p}{2-v+p}(p-c_o) + \frac{(h_p-2\bar{\alpha})^2}{4h_p}(p-c_o).$$

We next show that if $\pi_o^C(\frac{\bar{\alpha}}{\theta}) \le \pi_o^B$, we then reach to a strict inequality. We have

$$\Big[1 - \frac{(h_p-2\bar{\alpha})^2}{4h_p}\Big](\frac{v-p}{2-v+p})(p-c_o) + \frac{(h_p-2\bar{\alpha})^2}{4h_p}(p-c_o) \le (v-p)(p-c_o) \Longrightarrow (h_p - 2\bar{\alpha})^2 \le 2h_p(v-p)$$

$$\Longrightarrow (h_p - 2(p-c_p) + \frac{2(v-p)}{2-v+p}(p-c_o))^2 \le 2h_p(v-p).$$

Since $4(v-p)^2 \le 2h_p(v-p)$, then

$$\Big[h_p - 2(p-c_p) + \frac{2(v-p)}{2-v+p}(p-c_o)\Big] < 2(v-p) \Longrightarrow \frac{h_p - 2(v-p)}{2} \le (p-c_p) - \frac{v-p}{2-v+p}(p-c_o) = \bar{\alpha}.$$

3. $\bar{\alpha} < \frac{h_p-2(v-p)}{2}$. As in the second case, if $\pi_o^C(\frac{\bar{\alpha}}{\theta}) \le \pi_o^B$, then we reach a strict inequality.

$$\pi_o^C(\frac{\bar{\alpha}}{\theta}) = \frac{2\bar{\alpha} + (2-v+p)(v-p)}{h_p}(p - c_p - \bar{\alpha}) + (1 - \frac{v-p+2\bar{\alpha}}{h_p})(v-p)(p-c_o) \le (p-c_o)(v-p)$$

$$\Longrightarrow 2\bar{\alpha}(p-c_p-\bar{\alpha}) + (2-v+p)(v-p)(p-c_p-\bar{\alpha}) < (v-p+2\bar{\alpha})(v-p)(p-c_o).$$

Since $\bar{\alpha} = (p-c_p) - \frac{v-p}{2-v+p}(p-c_o)$, we have

$$2\bar{\alpha}\frac{v-p}{2-v+p}(p-c_o) + (2-v+p)(v-p)\frac{v-p}{2-v+p}(p-c_o) \le (v-p+2\bar{\alpha})(v-p)(p-c_o)$$

$$\Longrightarrow \frac{2\bar{\alpha}}{2-v+p} + v - p \le v - p + 2\bar{\alpha} \Longrightarrow 1 \le 2 - v + p,$$

where last inequity follows from $v-p<1$. We then have $\theta\bar{\bar{\beta}} \le \bar{\alpha}$.

Therefore, we conclude that when $\alpha = \theta\beta < \theta\bar{\bar{\beta}}$, we have $\pi_o^C(\beta) > \pi_o^F(\alpha) > \pi_o^B$, when $\theta\bar{\bar{\beta}} < \alpha = \theta\beta < \bar{\alpha}$, we have $\pi_o^F(\alpha) > \max\{\pi_o^C(\beta), \pi_o^B\}$, and when $\alpha = \theta\beta > \bar{\alpha}$, we have $\pi_o^B > \pi_o^F(\alpha) > \pi_o^C(\alpha)$. Thus, based on Propositions 2 and 4, when $c_s \le r + \theta\bar{\bar{\beta}} = \underline{c}_s$, the online retailer's profit under a beneficial coupon policy is higher relative to the fixed fee policy, and the coupon policy is beneficial for any $\beta \in [\max\{0, \frac{c_s - r}{\theta}\}, \bar{\bar{\beta}}]$. When $\underline{c}_s < c_s \le r + \bar{\alpha} = \bar{c}_s$, the online retailer's profit under a beneficial fixed fee policy is greater than a beneficial coupon policy, and the fixed policy is beneficial for any $\alpha \in [c_s - r, \bar{c}_s - r]$. Lastly, when $c_s > \bar{c}_s$, neither a fixed fee policy nor a coupon policy can improve the online retailer's profit when compared to the baseline policy, and hence the baseline policy is optimal. □

Proof of Proposition 6. We first show that when $c_p > v - \frac{h_p}{2} - \frac{(v-p)(p-c_o)}{h_p} = \bar{c}_p$, the hybrid policy cannot be optimal, and so the optimal policy remains the same as in Proposition 5.

When $c_p > \bar{c}_p$, we have $\bar{\bar{\beta}} \leq \frac{h_p - 2(v-p)}{2\theta}$, so that $\pi_o^C(\beta = \frac{h_p-2(v-p)}{2\theta}) < \pi_o^F(\alpha = \frac{h_p-2(v-p)}{2})$. We next show that when $c_p > \bar{c}_p$, the optimal policy is either the coupon policy or the fixed fee policy.

Although the online retailer's profit is a piece-wise function of β, in this case, it is enough to focus on the first part of the function (i.e., when $\beta \leq \frac{h_p-2(v-p)}{2\theta}$) because the coupon policy can be optimal only when $\beta \leq \frac{h_p-2(v-p)}{2\theta}$. We assume that there exists an optimal hybrid policy with parameters β_h^* and α_h^* (where $\beta_h^*, \alpha_h^* > 0$). Namely, β_h^* and α_h^* maximize the online retailer's profit, while satisfying the offline partner's rationality constraint $(r + \alpha_h^* + \theta\beta_h^* - c_s)d_s^H \geq 0$. Thus, the online retailer's profit under the hybrid policy must be higher than the profit under the coupon policy with the coupon value $\beta^* = \frac{\theta\beta_h^* + \alpha_h^*}{\theta}$ and the fixed fee policy with $\alpha^* = \theta\beta_h^* + \alpha_h^*$.

We let $\pi_o^H(\gamma = \theta\beta_h + \alpha_h)$ denote the online retailer's profit under the hybrid policy. For the online retailer's profit under the hybrid policy to be higher relative to the coupon policy, we must have the following (without loss of generality, we assume $\theta = 1$):

$$\pi_o^H(\gamma^* = \beta_h^* + \alpha_h^*) > \pi_o^C(\beta^*) \implies \frac{2\beta_h^* + (2-v+p)(v-p)}{h_p}(p - c_p - \beta_h^* - \alpha_h^*) + (1 - \frac{v-p+2\beta_h^*}{h_p})(v-p)(p-c_o) >$$
$$\frac{2\beta^* + (2-v+p)(v-p)}{h_p}(p - c_p - \beta^*) + (1 - \frac{v-p+2\beta^*}{h_p})(v-p)(p-c_o)$$
$$\implies \beta_h^* + \alpha_h^* > p - c_p - (v-p)(p-c_o). \tag{EC.3.2}$$

In addition, the online retailer's profit under the hybrid policy must be higher relative to fixed fee policy, that is,

$$\pi_o^H(\gamma^* = \beta_h^* + \alpha_h^*) > \pi_o^F(\alpha^*) \implies \frac{2\beta_h^* + (2-v+p)(v-p)}{h_p}(p - c_p - \beta_h^* - \alpha_h^*) + (1 - \frac{v-p+2\beta_h^*}{h_p})D(v-p)(p-c_o) >$$
$$\frac{(2-v+p)(v-p)}{h_p}(p - c_p - \alpha^*) + (1 - \frac{v-p}{h_p})(v-p)(p-c_o)$$
$$\implies \beta_h * + \alpha_h^* < p - c_p - (v-p)(p-c_o). \tag{EC.3.3}$$

Inequalities (EC.3.2) and (EC.3.3) cannot hold simultaneously, and so when $c_p > \bar{c}_p$, the hybrid policy cannot be optimal. The online retailer will opt either for the fixed fee policy or for coupon policy based on Proposition 5.

We next show that when $c_p < \bar{c}_p$ (i.e., $\bar{\bar{\beta}} > \frac{h_p-2(v-p)}{2\theta}$), the hybrid policy can be optimal only when $\underline{\underline{c}}_s = r + \frac{h_p-2(v-p)}{2} \leq c_s < r + p - c_p - (p-c_o)(v-p) = \bar{\bar{c}}_s$. When $c_p < \bar{c}_p$, there are three possible cases:

1. $c_s \leq \theta\check{\beta} + r$. Based on Propositions 4 and 5, the online retailer's profit is maximized when $\beta = \check{\beta}$, and since $c_s \leq \theta\check{\beta} + r$, $\beta = \check{\beta}$ satisfies the offline partner's rationality constraint, so that the coupon policy is optimal.

2. $\theta\check{\beta} + r < c_s \leq r + \bar{\alpha}$. In this case, the online retailer can maximize her profit under the fixed fee and coupon policies with parameters $c_s - r$ and $\frac{c_s - r}{\theta}$, respectively (i.e., to maximize her profit, the online retailer will pay the minimum compensation value under either policy, and so the offline partner's

rationality constraint is binding). Therefore, the online retailer determines the optimal decision by using the following optimization formulation:

$$\begin{aligned} \max_{\beta_h,\alpha_h} \quad & \pi_o(\gamma) = (p-c_o)d_o^H + (p-c_p-\alpha_h-\theta\beta_h)d_s^H \\ & (r+\alpha_h+\theta\beta_h-c_s)d_s^H \geq 0 \\ & \alpha_h+\theta\beta_h = c_s-r \\ & \alpha_h,\beta_h \geq 0. \end{aligned} \tag{EC.3.4}$$

As a result, it is enough to solve

$$\max_{\beta_h} \pi_o(\beta_h) = (p-c_o)d_o^H + (p-c_p-c_s+r)d_s^H. \tag{EC.3.5}$$

If $\beta_h^\dagger$ is the solution of Equation (EC.3.5), then the solution of Equation (EC.3.4) is $(\beta_h^*, \alpha_h^*) = (\beta_h^\dagger, c_s - r - \beta_h^\dagger)$. We will find $\beta_h^\dagger$ based on the first-order condition. The profit function $\pi_o(\beta_h)$ in Equation (EC.3.5) can be written as

$$\pi_o(\beta_h) = \begin{cases} (p-c_o)(1-\frac{v-p+2\theta\beta_h}{h_p})(v-p) + (p-c_p-c_s+r)\frac{2\theta\beta_h+(2-v+p)(v-p)}{h_p}, & 0 \leq \beta_h \leq \frac{h_p-2(v-p)}{2\theta} \\ (p-c_p-c_s+r) - \frac{(h_p-2\theta\beta_h)^2}{4h_p}(r+c_o-c_p-c_s), & \frac{h_p-2(v-p)}{2\theta} < \beta_h \leq \frac{h_p}{2\theta} \\ (p-c_p-c_s+r) & \beta_h \geq \frac{h_p}{2\theta} \end{cases}$$

Thus, the first derivative of $\pi_o(\beta_h)$ is given by:

$$\frac{\partial \pi_o}{\partial \beta_h} = \begin{cases} \frac{2\theta}{h_p}\Big[p-c_p-c_s+r-(p-c_o)(v-p)\Big], & 0 \leq \beta_h < \frac{h_p-2(v-p)}{2\theta} \\ \frac{\theta}{h_p}(h_p-2\theta\beta_h)(r+c_o-c_p-c_s), & \frac{h_p-2(v-p)}{2\theta} < \beta_h \leq \frac{h_p}{2\theta} \\ 0 & \beta_h \geq \frac{h_p}{2\theta} \end{cases}$$

Therefore, when $c_s > r + p - c_p - (p-c_o)(v-p)$, we have $\beta_h^\dagger = 0$. In this case, the optimal policy is the fixed fee policy. When $c_s < r + p - c_p - (p-c_o)(v-p)$, we have $\beta_h^\dagger = \frac{h_p-2(v-p)}{2\theta}$. In this case, the optimal policy can be either the coupon policy or the hybrid policy. More specifically, if $c_s \geq r + \frac{h_p-2(v-p)}{2}$, then the hybrid policy with $\beta_h^* = \frac{h_p-2(v-p)}{2\theta}$ and $\alpha_h^* = c_s - r - \frac{h_p-2(v-p)}{2\theta}$ is optimal. Otherwise, the coupon policy with $\beta^* = \frac{c_s-r}{\theta}$ is optimal.

3. $c_s > r + \bar{\alpha}$. In this case, based on Proposition 5, none of the policies are beneficial. □

As mentioned above, to avoid trivial cases, we assume $v - p < 1$ and $(v-p)/h_p < 1/2$. Here, we will explain the implications if these assumptions are relaxed.

If we relax the assumption of $v - p < 1$, under the baseline model, all customers in the market will purchase from the online retailer because $h_o \leq 1$. In this scenario, the pickup partnership will benefit the online retailer if and only if the profit margin of in-store pickup orders is higher than that of direct-delivery orders (i.e., $\alpha \leq c_o - c_p$ or $\theta\beta \leq c_o - c_p$). Since the coupon policy encourages more customers to use the in-store pickup service, the online retailer always prefers the coupon policy over the fixed fee policy. Therefore, when $v - p \geq 1$, the pickup partnership is beneficial for both parties if and only if $c_s \leq r + c_o - c_p$, and the coupon policy is preferred over the fixed-fee policy.

If we relax the assumption $(v-p)/h_p < 1/2$, under the fixed fee policy, all customers in the market will purchase from the online retailer. In this case, comparing the fixed fee policy and the coupon policy becomes less significant because the online retailer prefers the coupon policy over the fixed fee policy only when the profit margin of in-store pickup orders is higher than that of direct-delivery orders. This occurs because the additional market expansion driven by the coupon disappears when $(v-p)/h_p \geq 1/2$.

EC.4. Alternative Modeling Approaches

EC.4.1. Alternative Consumer Utility under the Fixed Fee Policy

Here, we consider an alternative modeling for customer utility such that customers who opt for the in-store pickup option gain an additional utility from making a purchase at the offline partner's store during their in-store pickup. Let's γ denote the additional utility customers derive from such cross-selling. In this case, the customer utility for in-store pickup orders under the fixed fee policy and coupon policy is equivalent to $u_p^F = v+\gamma-p-xh_p$ and $u_p^C = v+\gamma-p-xh_p+\theta\beta$, respectively. Similar to our main model, to avoid trivial cases, we assume that some customers leave the market under the fixed-fee policy (i.e., $0 \leq \gamma \leq (hp-2(v-p))/2$). Then, the demand functions for the direct-delivery and in-store pickup options under the fixed-fee policy are given by:

$$d_s^F = \frac{2\gamma+(v-p)(2-v+p)}{h_p} \quad \text{and} \quad d_o^F = \Big[1-\frac{(v-p+2\gamma)}{h_p}\Big](v-p).$$

Similarly, the demand functions for the direct-delivery and in-store pickup options under the coupon policy are given by:

$$d_s^C = \begin{cases} \frac{2\theta\beta+2\gamma+(2-v+p)(v-p)}{h_p}, & 0 \leq \beta \leq \frac{h_p-2(v-p-\gamma)}{2\theta} \\ (1-\frac{(h_p-2\theta\beta-2\gamma)^2}{4h_p}) & \frac{h_p-2(v-p-\gamma)}{2\theta} \leq \beta \leq \frac{h_p-2\gamma}{2\theta} \\ 1 & \beta \geq \frac{h_p-2\gamma}{2\theta} \end{cases}$$

$$\text{and} \quad d_o^C = \begin{cases} (1-\frac{(v-p+2\theta\beta+2\gamma)}{h_p})(v-p), & 0 \leq \beta \leq \frac{h_p-2(v-p-\gamma)}{2\theta} \\ \frac{(h_p-2\theta\beta-2\gamma)^2}{4h_p}, & \frac{h_p-2(v-p-\gamma)}{2\theta} \leq \beta \leq \frac{h_p-2\gamma}{2\theta} \\ 0, & \beta \geq \frac{h_p-2\gamma}{2\theta} \end{cases}$$

Following the same proof procedure as in E-Companion EC.3, we can show that the findings from our main model continue to hold under this alternative model.

EC.4.2. Alternative Offline Partner Profit under the Coupon Policy

We consider that some customers redeem the coupon towards the purchase of r at the offline partner store whereas others redeem it to increase their purchase from the offline partner to $r+\beta$. To model this alternative coupon redemption scenario, let ζ denote the probability that the coupon is redeemed towards the purchase of $r+\beta$ and $1-\zeta$ denote the probability that the coupon is redeemed towards the purchase of r. Note that this assumption does not impact the demand functions because the customer's utility from the coupon remains the same regardless of whether the customer uses it to purchase more or to cover the cost of r. Additionally, the online partner must still pay β for each redeemed coupon. Therefore, the profit margin of in-store pickup orders is still $p-c_p-\theta\beta$ for the online retailer. Hence, the results from our main model remain the same with this alternative approach, except for the lower bound of the coupon value (i.e., $\underline{\beta}$). Under the alternative coupon redemption scenario, the coupon policy is beneficial for the offline partner if and only if $\beta \geq \underline{\beta} = \min\{0, \frac{c_s-r}{\zeta\theta}\}$.

EC.4.3. Alternative Comparison for the Optimal Policy

In the main text, we compare the fixed-fee and coupon policies under the constraint that the average compensation per in-store pickup order is identical across the two policies (i.e., $\alpha = \theta\beta$). In this section, we relax this restriction and compare the two policies for general values of α and β.

Specifically, we evaluate the online retailer's profit under the baseline, fixed-fee, and coupon policies while varying α and β, and identify the regions in which the online retailer prefers the fixed-fee or the coupon policy. Figure EC.4.1 presents the results in three panels corresponding to low, medium, and high values of the parameter c_s (with parameters set as follows: $v = 1$, $p = 0.8$, $c_p = 0.3$, $c_o = c_p + 0.1$, $h_p = 0.95$, $\theta = 1$, $r = 0.0$). In each panel, we also plot the line $\alpha = \theta\beta$, which represents the constraint imposed in our main analysis.

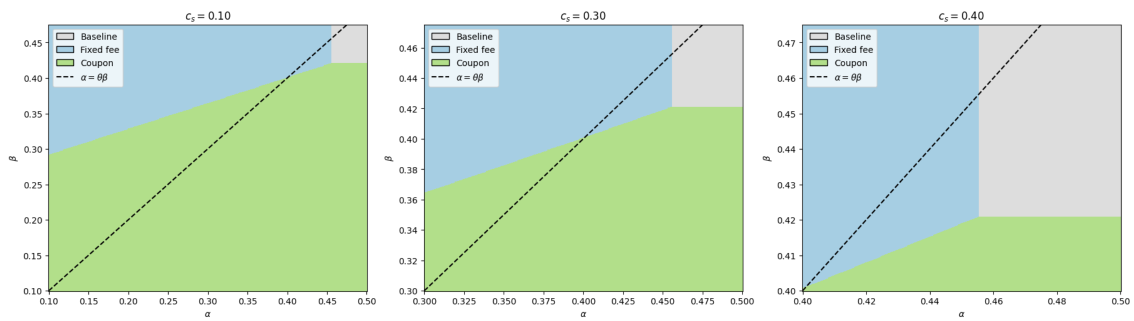


Figure EC.4.1

These three panels yield several insights. First, within each panel, moving from the southwest corner to the northeast corner corresponds to a shift in bargaining power from the online retailer to the offline retailer. This is because the online retailer's profit decreases in both α and β, whereas the offline retailer's profit increases in α under the fixed-fee policy and in β under the coupon policy. Consequently, regions with low values of α and β (i.e., the southwest corner) correspond to stronger bargaining power for the online retailer, while regions with high values of α and β (i.e., the northeast corner) correspond to stronger bargaining power for the offline retailer.

Second, consider the left two panels, where c_s is low or medium. When the online retailer has relatively stronger bargaining power, she prefers the coupon policy. In this region, both α and β are small, so neither policy is very costly for the online retailer; however, the coupon policy stimulates demand more effectively than the fixed-fee policy. As a result, the online retailer prefers the coupon policy for low values of α and β. As bargaining power shifts toward the offline retailer, the online retailer instead prefers the fixed-fee policy. When α and β are high, the high value of β under the coupon policy induces more customers to switch to the pickup option, increasing the online retailer's cost. In contrast, under the fixed-fee policy, customers' relative preferences between online delivery and pickup do not change, which enables the online retailer to sustain the partnership in a more cost-effective manner.

Finally, when c_s is sufficiently high (see the right panel), the fixed-fee policy becomes optimal as long as either α or β is sufficiently low. Overall, these findings are consistent with the results characterized in Proposition 5 in Section 4.3.

As an additional robustness check, we also compare the fixed fee and coupon policies by considering that the average optimal compensation per in-store pickup order is the same under both policies (i.e., $\alpha^* = \theta\beta^*$). Recall from *Proposition 2* that the fixed fee policy is beneficial for both partners if $\alpha \in [\underline{\alpha}, \bar{\alpha}]$, and the online retailer's profit decreases as α increases. Therefore, the optimal α for the online retailer is $\alpha^* = \underline{\alpha} = \max\{0, c_s - r\}$. Similarly, recall from *Proposition 4* that the optimal coupon value (i.e., β) is $\beta^* = \max\{\frac{c_s - r}{\theta}, \check{\beta}\}$. Under these optimal conditions, one can show that $\alpha^* = \theta\beta^*$ unless $c_s \leq \theta\check{\beta} + r < \underline{c}_s$. The second part of this inequality results from our earlier discussion that $c_s = r + \theta\bar{\bar{\bar{\beta}}}$. In this case, $\beta^* = \check{\beta} \geq \frac{c_s - r}{\theta}$ and $\alpha^* = c_s - r$. Since $\pi_o^F(\alpha = 0) = \pi_o^C(\beta = 0)$, as shown in the proof of *Proposition 4*, the online retailer will prefer the coupon policy over the fixed fee policy in this scenario. Therefore, our results remain valid under the optimal values of α and β.

EC.5. Details for Comparative Statics

We let $\Delta\pi_o^{C-F}$ denote the difference in the online retailer's profit between the coupon policy and the fixed fee policy with the same average compensation value per pickup order (i.e., $\alpha = \theta\beta$). We first characterize how $\Delta\pi_o^F$, $\Delta\pi_o^C$, and $\Delta\pi_o^{C-F}$ are changing with respect to c_p and c_o. We have

$$\frac{\partial \Delta\pi_o^F}{\partial c_p} = -\frac{(v-p)(2-v+p)}{h_p} < 0 \quad \text{and} \quad \frac{\partial \Delta\pi_o^C}{\partial c_p} = -\Big[\frac{(v-p)(2-v+p)}{h_p} + \frac{(1-v+p)}{h_p}\hat{\hat{\beta}} + \frac{(v-p)}{h_p}\hat{\beta}\Big] < 0.$$

Thus, we conclude that the profitability of the fixed fee and coupon policies decreases with c_p. We also have

$$\frac{\partial \Delta\pi_o^{C-F}}{\partial c_p} = -\Big[\frac{(1-v+p)}{h_p} + \frac{(v-p)}{h_p}\hat{\beta}\Big] < 0.$$

Since $\frac{\partial \Delta\pi_o^{C-F}}{\partial c_p} < 0$, we conclude that the profitability of the coupon policy decreases with c_p faster than that of the fixed fee policy.

Similarly, for c_o, we have

$$\frac{\partial \Delta\pi_o^F}{\partial c_o} = \frac{(v-p)^2}{h_p} > 0 \quad \text{and} \quad \frac{\partial \Delta\pi_o^C}{\partial c_o} = \frac{(v-p)^2}{h_p} + \frac{(v-p)}{h_p}\hat{\beta} > 0.$$

Thus, we conclude that the profitability of the fixed fee and coupon policies increases with c_o. We also have

$$\frac{\partial \Delta\pi_o^{C-F}}{\partial c_o} = \frac{(v-p)}{h_p}\hat{\beta} > 0.$$

Since $\frac{\partial \Delta\pi_o^{C-F}}{\partial c_o} > 0$, we conclude that the profitability of the coupon policy increases with c_o faster than the fixed fee policy. Next, we show how $\Delta\pi_o^{C-F}$ changes with respect to p.

$$\Delta\pi_o^{C-F} = \begin{cases} \frac{2\theta\beta(1-v+p)}{h_p}(p - c_p - \theta\beta + \frac{2\theta\beta(v-p)}{h_p}(c_o - c_p - \theta\beta)) & p \geq \theta\beta + v - \frac{h_p}{2} \\ \frac{(h_p - 2v + 2p)(1-v+p)}{2h_p}(p - c_p - \theta\beta) + (\theta\beta - \frac{(\theta\beta)^2}{h_p} - \frac{(h_p - 2(v-p))^2}{4h_p})(c_o - c_p - \theta\beta) & p \leq \theta\beta + v - \frac{h_p}{2}, \beta \leq \frac{h_p}{2\theta} \\ \frac{(h_p - 2(v-p))(1-v+p)}{2h_p}(p - c_p - \theta\beta) + (1 - \frac{v-p}{h_p})(v-p)(c_o - c_p - \theta\beta) & p \leq \theta\beta + v - \frac{h_p}{2}, \beta > \frac{h_p}{2\theta} \end{cases}$$

More specifically, $\frac{\partial \Delta\pi_o^{C-F}}{\partial p}$ can be characterized as follows:

- When $p \geq \theta\beta + v - \frac{h_p}{2}$, we have

$$\frac{\partial \Delta\pi_o^{C-F}}{\partial p} = \frac{2\theta\beta}{h_p}(1 - v + 2p - c_o) \geq 0.$$

- When $p \le \theta\beta + v - \frac{h_p}{2}$, $\theta\beta \le \frac{h_p}{2}$, we have

$$\frac{\partial \Delta\pi_o^{C-F}}{\partial p} = \frac{1}{2h_p}\Big[(p-c_p-\theta\beta)(2(1-v+p)+(h_p-2(v-p))+(h_p-2(v-p))(1-v+p-2(c_o-c_p-\theta\beta))\Big].$$

When $c_o \le c_p + \theta\beta$, we can show that $\frac{\partial \Delta\pi_o^{C-F}}{\partial p} > 0$. When $c_o > c_p + \theta\beta$, it is enough to show that

$$2(p-c_p-\theta\beta)(1-v+p)+(p-c_p-\theta\beta)(h_p-2(v-p))+(h_p-2(v-p))(1-v+p) \ge 2(c_o-c_p-\theta\beta)(h_p-2(v-p))$$

so that

$$\frac{2(p-c_p-\theta\beta)(1-v+p)}{(h_p-2(v-p))} + (p-c_p-\theta\beta) + (1-v+p) \ge 2(c_o-c_p-\theta\beta),$$

where the above inequality follows from $p + c_p + \theta\beta + 1 - v + p \ge 2c_o$.

- When $p \le \theta\beta + v - \frac{h_p}{2}$, $\theta\beta > \frac{h_p}{2}$, we have

$$\frac{\partial \Delta\pi_o^{C-F}}{\partial p} = \frac{1}{h_p}((1-v+p)(p-c_p-\theta\beta) + \frac{(h_p-2(v-p))(p-c_p-\theta\beta)}{2} + \frac{(h_p-2(v-p))(1-v+p)}{2} + (c_o-c_p-\theta\beta)(2(v-p)-h_p)).$$

Since $p + c_p + \theta\beta + 1 - v + p \ge c_o$, we can show that $\frac{\partial \Delta\pi_o^{C-F}}{\partial p} > 0$ when $p \le \theta\beta + v - \frac{h_p}{2}$ and $\theta\beta > \frac{h_p}{2}$.

As a result, by increasing p, the coupon policy becomes more profitable for the online retailer.

EC.6. Numerical Analysis

EC.6.1. Coupon-Dependent Cross-Selling.

To examine the robustness of our results to coupon-dependent cross-selling effects, we extend the model by allowing the offline partner's per-order cross-selling benefit to increase with coupon value. Specifically, we assume

$$r(\beta) = r_0 + w\beta,$$

where r_0 denotes the baseline cross-selling benefit and $w \ge 0$ captures the sensitivity of cross-selling to the coupon value. This specification reflects the idea that more generous coupons may induce larger add-on purchases or higher in-store spending, while preserving tractability. We evaluate this extension numerically (with parameters set as follows: $v = 1,\ p = 0.8,\ c_p = 0.3,\ h_p = 0.95,\ c_o = c_p + 0.1,\ r_0 = 0.01,\ \theta = 0.5,$ and $c_s \in [0, 0.60]$.) by optimizing the coupon policy over β for each c_s and for different values of w. Figure EC.6.1 illustrates how changes in w affect the optimal policy choice and the online retailer's profit. As expected, a higher w strengthens the offline partner's incentive to participate and can expand the parameter region in which the coupon policy is optimal, while the qualitative structure of the policy trade-offs remains unchanged.

EC.6.2. Endogenous Coupon Redemption Probability

In this subsection, we examine the robustness of our main results when the coupon redemption probability is endogenous and increasing in the coupon value. This extension captures the realistic feature that customers are more likely to redeem more generous coupons. Formally, we assume that the redemption probability is given by

$$\theta(\beta) = \min\{1,\ \theta_0 + \gamma\beta\}, \tag{EC.6.1}$$

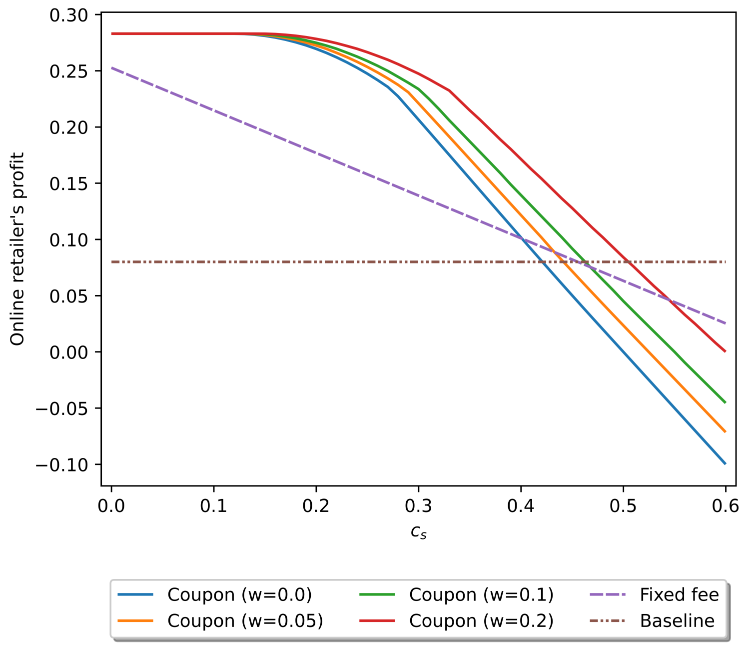


Figure EC.6.1 Impact of w on the optimal policy

where $\theta_0 \in (0,1)$ denotes the baseline redemption probability and $\gamma \geq 0$ measures the sensitivity of redemption to coupon value. This specification ensures that $\theta(\beta) \in [0,1]$ and nests the baseline model as a special case when $\gamma = 0$.

Under this extension, the coupon affects customer utility and firm profits only through the composite term $\theta(\beta)\beta$. Accordingly, throughout the analysis we replace $\theta\beta$ with $\theta(\beta)\beta$ in the customer utility, demand allocation, and profit expressions. The structure of the model and the logic of the policy comparison remain unchanged, except that the online retailer effectively chooses an *effective coupon* $\tilde{\beta} = \theta(\beta)\beta$ through its choice of the nominal coupon β.

Figure EC.6.2 summarizes the numerical implications of this extension (with parameters set as follows: $v = 1$, $p = 0.8$, $c_p = 0.3$, $h_p = 0.95$, $c_o = c_p + 0.1$, $r_0 = 0.1$, $\theta_0 = 0.3$, and $c_s \in [0, 0.60]$). Panel (a) plots the online retailer's profit under the coupon policy for different values of γ, together with the fixed-fee and baseline benchmarks. The profit curves under the coupon policy largely overlap across values of γ, indicating that endogenizing redemption has only a limited impact on the retailer's profit. Importantly, the qualitative ranking of policies remains unchanged.

Panel (b) reports the optimal nominal coupon value β^* as a function of the offline handling cost c_s. As expected, when redemption becomes more sensitive to coupon value (higher γ), the optimal nominal coupon β^* is lower for any given c_s. This reflects the retailer's incentive to reduce the face value of the coupon when a higher redemption rate can be achieved with a smaller discount.

Panel (c) shows the resulting redemption probability $\theta(\beta^*)$. Higher values of γ lead to higher realized redemption rates, especially for larger values of c_s where stronger incentives are required to induce pickup adoption. Together, Panels (b) and (c) illustrate that the retailer trades off the nominal coupon value against the redemption probability when choosing β^*.

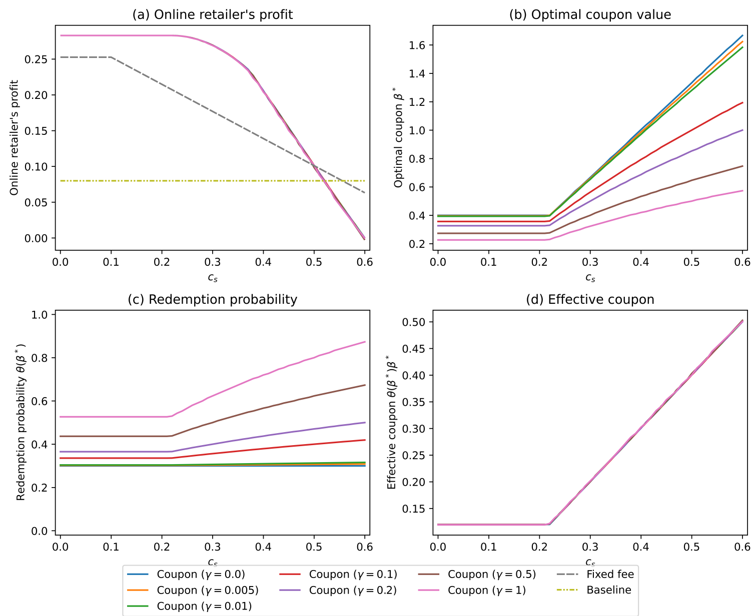


Figure EC.6.2 Endogenous coupon redemption probability.

Panel (d) plots the optimal *effective coupon* $\theta(\beta^*)\beta^*$ as a function of c_s. Despite substantial variation in both β^* and $\theta(\beta^*)$ across different values of γ, the effective coupon is remarkably stable and increases monotonically in c_s. This finding highlights the key insight of the analysis: policy outcomes depend primarily on the composite term $\theta(\beta)\beta$, and endogenizing redemption mainly rescales the mapping between the nominal coupon and its effective incentive without altering the main trade-offs or qualitative conclusions of the model.