Marketplace or Reseller? Optimal Platform Model under Disintermediation*

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Abstract. This paper examines how a platform facing disintermediation (marketplace leakage) optimally deploys a hybrid business model that combines marketplace and reseller functions. We develop a game-theoretic framework featuring a monopolistic platform and an integrated supplier acting as a wholesaler to the platform and a retailer to consumers. Consumers who discover the supplier on the marketplace can bypass the platform and purchase from the supplier's direct channel, creating a leakage problem for the platform. Additionally, demand uncertainty exposes the platform to inventory risk, which prevents it from adopting a pure reseller mode. In equilibrium, the supplier sets a wholesale price such that the platform optimally deploys the hybrid model, balancing the risk-free marketplace mode and the higher-margin reseller mode. Notably, when consumers' leakage propensity is relatively strong, a worsening leakage problem can shift the platform back toward the marketplace mode. Extending the baseline analysis, we further examine scenarios in which the platform may implement a non-hybrid business model. In particular, the platform deviates to a pure reseller mode if the supplier can costlessly provide a product return policy, but prefers a pure marketplace mode when it can invest in transaction benefits at a sufficiently low cost or when it faces fierce supplier competition.

Keywords: disintermediation, showrooming, hybrid platforms, two-sided markets, business model

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1 Introduction

Two-sided platforms or intermediaries typically generate profit through two primary models: operating as a marketplace that charges transaction fees, or a reseller that procures and resells products. The choice between these two modes reflects trade-offs regarding whether a platform allocates decision rights to third-party sellers or retains them itself. In practice, rather than committing exclusively to either mode, many digital platforms adopt a hybrid business model that integrates both marketplace and reseller functions. Prominent examples include Amazon, JD.com, and Walmart,[1] which provide a marketplace for third-party sellers while also operating their own first-party stores. On the supplier side of the market, firms routinely operate as both wholesalers that sell to platforms (B2B) and retailers that sell to consumers (B2C). Moreover, in addition to running flagship stores on a platform's marketplace, suppliers may also retail through their own sites and apps. On JD.com, for instance, major electronics brands commonly appear in JD's first-party assortment and as marketplace flagship stores while also selling through their own channels.

Given that platforms charge transaction fees for products sold on their marketplaces, suppliers are motivated to bypass the intermediary and directly sell to consumers through their own channel once an initial match has been made. This is typically achieved by offering a lower price in the direct channel. This disintermediation problem, commonly referred to as marketplace leakage or showrooming, arises when consumers discover suppliers through the platform's marketplace but complete transactions off-platform. Disintermediation is a common issue faced by platforms with the marketplace function (Hagiu and Wright, 2024; Gu, 2024; Han *et al.*, 2026).

The prior literature on platforms and intermediaries has explored the strategic choice between the marketplace and reseller modes, as well as the adoption of the hybrid business model (Hagiu and Wright, 2015; Tian *et al.*, 2018; Gautier *et al.*, 2023; Hervas-Drane and Shelegia, 2025). Moreover, existing work has studied platforms' pricing strategies under marketplace leakage (Hagiu and Wright, 2024; Enache and Rhodes, 2025). Despite the prevalence of hybrid platforms and the persistent threat of disintermediation, the economic mechanisms governing how platforms optimize their business models in the face of disinter-

[1] While Amazon started as a first-party retailer, 58% of physical gross merchandise sold on Amazon was from third-party sellers in 2018 (see Amazon's 2018 Letter to Shareholders). JD describes its e-commerce business as online retail and online marketplace. In the online retail business, it acquires products from suppliers and sells them directly to customers primarily through its mobile apps and websites. In the online marketplace business, third-party merchants sell products to customers primarily through its mobile apps and websites (see JD's SEC filing). Walmart is a direct retailer and also operates a third-party marketplace. Its 2025 Form 10-K describes Walmart's own merchandise categories and separately states that some products purchased through its website are sold by third parties, which Walmart calls marketplace transactions.

mediation remain largely underexplored. This paper bridges this gap by examining how the threat of leakage challenges the pure marketplace model and providing novel insights into the platform's adoption of a hybrid business model as an endogenously determined strategy. Specifically, we show that the hybrid business model arises not as an upfront design choice, but as the platform's inventory-choice response to the wholesale price of a supplier empowered by leakage.

In this paper, we develop a game-theoretic framework featuring a monopoly platform and a monopoly supplier to study how marketplace leakage affects the platform's optimal business model. The supplier functions as both a wholesaler and a retailer, selling its product through three distinct channels: wholesale to the platform, retail via the platform's marketplace, and its own direct channel. Importantly, the platform endogenously determines its business model, choosing among two pure operating modes and a hybrid configuration. As a marketplace, it charges a transaction fee to the supplier; as a reseller, it procures a specific quantity of the product from the supplier and resells it to consumers at a chosen resale price. Consumers prefer to use the platform and face heterogeneous switching costs when buying from the direct channel, which reflect the superior services provided by the platform (e.g., payment security, fast shipping, and after-sales support). Consequently, when the supplier offers a lower price in the direct channel, some consumers are incentivized to switch, causing a leakage problem for the platform. In addition to marketplace leakage, we incorporate a second fundamental friction commonly faced by platforms: uncertainty of consumer demand.[2] Within our framework, the platform makes its procurement decision prior to the realization of market demand. Consequently, demand uncertainty affects the platform's optimal business model through two channels: directly, via the platform's own exposure to inventory risk, and indirectly, through the supplier's adjustment of the wholesale price.

Furthermore, the platform acts as a gatekeeper with recommendation power: it can choose whether to make its own procured inventory or the supplier's marketplace listing visible to consumers through product recommendations. Specifically, consumers who are recommended the platform's product observe only the resale price and remain unaware of the supplier's marketplace listing or its direct channel, while those recommended the supplier's product observe the supplier's prices in both channels. Therefore, in our framework, prioritizing its own inventory in recommendations defends the platform against disintermediation: a consumer steered to the platform's product cannot discover, and hence cannot defect to, the supplier's direct channel.

[2]Inventory risk is a key distinction between the two modes. Under the reseller model, the platform obtains control over goods before they are transferred to customers and recognizes revenue on a gross basis. Under the marketplace model, the platform does not take ownership of inventory and records only the net commission as revenue (see Coupang's 2024 Annual Report).

Our main findings show that under marketplace leakage and demand uncertainty, the platform optimally adopts the hybrid model in equilibrium. The distinct economic forces underlying the two pure operating modes drive this result. On the one hand, the pure reseller mode is highly profitable for both the platform and the supplier. Because it centralizes the retail transaction, the reseller mode eliminates the economic inefficiencies caused by consumers' switching costs and minimizes consumer surplus, thereby maximizing the joint profits of the platform and the supplier. However, the reseller mode forces the platform to bear inventory risk: since the platform makes its procurement decision prior to the realization of market demand, the platform incurs a loss on unsold goods if demand falls below the procured quantity. On the other hand, the pure marketplace mode shields the platform from inventory risk, as the platform only facilitates transactions without taking ownership of inventory. In the baseline model, the supplier's equilibrium wholesale price provides the platform with a resale margin (i.e., the resale price net of the wholesale price) that exceeds the marketplace margin (i.e., fee income net of leakage). Consequently, the platform procures a positive quantity while the inventory risk prevents it from adopting a pure reseller mode, implying a hybrid business model. This paper thus provides a novel insight into why platforms optimally adopt a hybrid business model combining both marketplace and reseller functions.

A key distinction of our framework lies in the specification of market power. While the extant literature predominantly treats the supplier as a price-taker vis-à-vis the platform, our model accounts for bilateral market power. Specifically, leakage provides the supplier market power to determine the wholesale price. Consequently, the platform's adoption of the hybrid model emerges endogenously as an equilibrium outcome of the strategic interplay between the two parties. Furthermore, our comparative statics reveal that as consumers' leakage propensity increases (i.e., switching costs to the direct channel become lower) or as demand becomes less uncertain (i.e., inventory risk declines), the supplier's equilibrium wholesale price increases. Notably, as consumers' leakage propensity increases, the platform's business model can shift toward the marketplace mode (i.e., procurement decreases), highlighting the nuanced interaction between the supplier's wholesale pricing and the platform's procurement decision.

To establish the robustness of our main finding and delineate its boundaries, we extend the baseline model along five dimensions. First, we examine the platform's optimal business model when it can make upfront commitment to a pure marketplace or a pure reseller. We find that the platform never strictly benefits from pure-marketplace commitment while prefers pure-reseller commitment when consumers' leakage propensity and demand uncertainty are sufficiently high. Second, we show that when the platform transacts with indepen-

dent suppliers comprising a pure wholesaler and a pure retailer, the hybrid model remains optimal under leakage and demand uncertainty. Third, we introduce a supplier-provided return policy for unsold inventory so that the platform's procurement cost is no longer fully sunk, partially mitigating its inventory risk. We find that if providing such a policy is not strictly costless for the supplier, full returns never arise in equilibrium. Consequently, the platform continues to bear inventory risk, and the hybrid model remains optimal. Fourth, we endogenize the platform's investment in transaction benefits that consumers exclusively enjoy when purchasing on-platform. This reveals a critical boundary condition: when the cost of investing in these benefits is sufficiently low, the platform optimally reverts to a pure marketplace; otherwise, the hybrid model prevails. Finally, we incorporate supplier competition, i.e., the platform faces multiple suppliers that are heterogeneous in marginal costs and in their abilities to induce leakage. We find that the supplier with the lowest marginal cost consistently wins the market. Notably, a supplier's relative ability to induce leakage does not alter this competitive outcome.

The remainder of this paper is organized as follows. Section 2 summarizes the related literature on platform business models and platform leakage. Next, Section 3 presents the baseline model and derives the comparative statics with respect to leakage propensity and demand uncertainty. Subsequently, Section 4 extends the baseline model to incorporate the platform's commitment, independent suppliers, return policies, investment in transaction benefits, and competing suppliers. Finally, Section 5 presents the managerial implications for both platforms and suppliers, and Section 6 concludes.

2 Related Literature

This paper contributes to the extensive literature on platform business models, which examines the strategic trade-off between operating as a pure marketplace versus a traditional reseller (Hagiu and Wright, 2015; Abhishek *et al.*, 2016; Hu *et al.*, 2022). Increasingly, however, platforms are deviating from these pure modes (i.e., choosing between a marketplace and a reseller) to adopt a "hybrid" structure, concurrently hosting third-party suppliers and retailing their own products. Existing studies attribute this structural shift to various theoretical and operational drivers, including pessimistic expectations about supplier participation and the information disadvantage of platforms (Hagiu and Wright, 2015), upstream supplier competition and order-fulfillment costs (Tian *et al.*, 2018), consumer search dynamics across centralized and decentralized markets (Gautier *et al.*, 2023), and the need to manage internal capacity alongside third-party competition via storefront control (Hervas-Drane and Shelegia, 2025).

The chosen operational mode significantly alters the platform's strategic interactions with its ecosystem. For instance, the marketplace mode provides stronger incentives for information sharing (Zha *et al.*, 2023), while hybrid platforms demonstrate strategic flexibility by adjusting fees in response to third-party supplier cooperation (Bisceglia and Padilla, 2023). The literature also highlights the consumer welfare implications of these structural choices, demonstrating how first-party sales affect retail prices and product variety (Anderson and Bedre-Defolie, 2022, 2024). We expand upon this stream by introducing marketplace leakage and demand uncertainty as novel fundamental drivers that compel platforms to adopt a hybrid structure, even when facing a monopolistic supplier.

The early literature on disintermediation and leakage primarily focused on manufacturers mitigating retail free-riding across traditional channels (Telser, 1960; Mathewson and Winter, 1984), offline showrooming (Mehra *et al.*, 2017; Jing, 2018), and consumer search across multiple online and offline channels (Wu *et al.*, 2004; Loginova, 2009; Balakrishnan *et al.*, 2014; Bar-Isaac and Shelegia, 2023). Our setting is distinct in that leakage arises from consumers bypassing a platform to purchase from the exact same supplier via its direct channel. Consequently, this study connects to a growing body of theoretical work modeling online platform leakage. Seminal works have explored various platform countermeasures, including buyer heterogeneity and partial leakage (Hagiu and Wright, 2024), "front-loaded" pricing schemes for repeated transactions (Enache and Rhodes, 2025), and robust refund policies coupled with reduced supplier screening (Casner, 2024). A significant focus has also been placed on the welfare implications of price-parity clauses (PPCs) and cross-channel coherence as tools to combat disintermediation (Wang and Wright, 2020; Boorsma, 2023; Peitz and Sobolev, 2024). Although Hagiu *et al.* (2022) also examine a platform's optimal operational mode in the presence of a seller's direct channel, the platform commits to its chosen mode in their framework. In contrast, we allow the platform to endogenously determine its business model contingent upon observing the wholesale price set by the supplier.

Complementing these theoretical models, empirical studies confirm the prevalence and consequences of leakage across diverse digital platforms (Sullivan, 2025; Han *et al.*, 2026). Leakage has been widely documented in freelancing (Gu and Zhu, 2021), peer-to-peer healthcare (Zhou *et al.*, 2022), cargo delivery (Xie and Zhu, 2023), and pet care services (Farronato *et al.*, 2024). This literature identifies trust and technology as key enablers; as users build trust and technology facilitates direct communication, the platform's protective value proposition diminishes (Gu, 2024). Crucially, a platform's vulnerability depends heavily on transaction and user characteristics. While immediate, unpredictable services resist disintermediation (Edelman and Hu, 2016), services that are repeated, standardized, or require close coordination are highly susceptible (Gu and Zhu, 2021; Hagiu and Wright, 2024). Fur-

thermore, experienced providers with loyal customer bases (Zhou *et al.*, 2022), as well as new suppliers experiencing a surge in sales (Chintagunta *et al.*, 2023), are disproportionately likely to bypass the platform.

Despite robust independent streams of literature on platform business models and disintermediation, their intersection remains under-explored. Most relevant to this study, Hagiu and Wright (2015) call for future research to relax the assumption that buyers must go through the intermediary to connect with suppliers so that leakage can challenge the profitability of the pure marketplace mode. Hagiu and Wright (2024) provoke a research direction in exploring how platform leakage may lead marketplaces to adopt a more radical change in their business model; that is, to stop being marketplaces altogether and instead provide the product or service themselves. This work responds to the calls from Hagiu and Wright (2015) and Hagiu and Wright (2024) by endogenously embedding the choice of intermediary mode into a framework of platform leakage. We demonstrate how leakage reshapes the platform's optimal business model and provide novel insights into why a platform may optimally adopt a hybrid structure that integrates both marketplace and reseller functions. Importantly, a key distinction of our framework lies in the market power of the supplier. While prior literature predominantly models the supplier as a price-taker vis-à-vis the platform, our model endows both parties with bilateral market power. That is, the supplier can set its wholesale price strategically, enabled by its ability to induce leakage. Consequently, the platform's adoption of a hybrid model emerges endogenously as an equilibrium outcome of the strategic interplay between both parties.

3 Baseline Model

3.1 Assumptions

Consider a monopoly platform M, a monopoly supplier (manufacturer) S and a continuum of consumers. S produces one product and each consumer seeks to purchase one unit of the product. The product is valued at v by all consumers and it incurs a marginal cost of c, where $0 \leq c < v$.

We model S as an integrated supplier that functions as both a wholesaler and a retailer. Specifically, S can sell its product to M or consumers through three channels: (i) wholesale to M, (ii) retail to consumers via M's marketplace, and (iii) retail through its own direct channel. Thus, S sets three different prices: a wholesale price w, a retail price on the platform p_m, and a retail price in its direct channel p_d.

The platform M provides a marketplace for S and may also procure products from S,

depending on the wholesale price. Consequently, M's business model emerges endogenously in equilibrium rather than being determined by an upfront commitment.[3] As a marketplace, M charges S a per-unit transaction fee f for each sale completed on the marketplace.[4] As a reseller, M procures a quantity q_m from S and resells it to consumers at a resale price p_{resale}. After observing S's retail prices, M chooses which product to make available to each consumer: its own product procured from S, or the product sold by S on the marketplace. We refer to this choice as product recommendations. In particular, we assume that M must recommend an available product to every consumer. Thus, it can neither withhold recommendations nor recommend its own product to a mass of consumers exceeding its inventory q_m.

Upon joining M, consumers receive a product recommendation from M. If consumers receive a recommendation for M's product, they observe M's resale price p_{resale} but remain unaware of S's presence either on the marketplace or in the direct channel. Consequently, these consumers choose to buy M's product or exit the market, obtaining a utility of zero. If consumers receive a recommendation for S's product, they observe S's marketplace price p_m and the direct price p_d. These consumers then decide whether to purchase on the marketplace, switch to the direct channel, or exit the market. This assumption formalizes the platform's gatekeeping role, following the literature on platform steering and leakage (e.g., Hagiu *et al.*, 2022; Hagiu and Wright, 2024), where recommendations serve as a prerequisite for supplier discovery. This recommendation-gated discovery structure is a deliberate abstraction of default prominence on digital platforms: buy-box assignment, algorithmic ranking, and featured placement determine which offer the marginal consumer actually evaluates. It is an appropriate assumption where the first-party listing does not make the supplier's identity and direct channel salient, or where search costs for the brand's own channel are non-trivial. One implication is worth stating explicitly: leakage in our model arises only among the residual demand the platform itself routes to the supplier, so disintermediation is partly an outcome of the platform's own recommendation policy rather than involuntary showrooming. In Section A.2, we examine a scenario where a small fraction of consumers can discover S in the direct channel without relying on M's recommendations, and we demonstrate that our main results remain robust.

Consumers prefer to use M and face a switching cost (disutility) s when buying directly from S, which is drawn from a distribution $G(s)$ over the support $[0, \mu]$. Consumers thus have a heterogeneous net valuation $v - s$ when purchasing from the direct channel. Impor-

[3] In the baseline, M cannot commit to a pure business model. Section 4.1 relaxes this assumption and examines the conditions under which M benefits from such a commitment.

[4] Because consumers share a common valuation, replacing the per-unit transaction fee with a percentage commission does not change our analysis. See the proof of Lemma 1 for details.

tantly, the total consumer demand q is uncertain and is drawn from a distribution $H(q)$ over the support $[\underline{q}, \bar{q}]$, where $0 \leq \underline{q} < \bar{q}$. We assume that $G(\cdot)$ and $H(\cdot)$ are continuously differentiable. The consumer demand can be interpreted in multiple ways without changing our results. For expositional simplicity, we interpret demand as the mass of consumers in the market. The demand is realized after M and S set prices and before M makes product recommendations. Although both M and S face demand uncertainty, the associated inventory risk is borne by M, which must commit to a procurement quantity prior to the realization of market demand. This ex-ante capital commitment typically arises from the contractual arrangement between the platform and the supplier. By contrast, we model S's production process as make-to-order. This specification reflects the operational reality of a manufacturer that controls production timing and benefits from demand pooling across the platform's wholesale orders, the marketplace, and its own direct channel.

The timeline is as follows: (i) M sets the per-unit transaction fee f and S sets the wholesale price w simultaneously;[5] (ii) given w, M decides the quantity q_m of the product to procure from S; (iii) M sets its resale price p_{resale} and S decides whether to list its product on the marketplace, setting the marketplace and direct-channel retail prices, p_m and p_d respectively, if it chooses to enter; (iv) the demand q is realized, and upon observing q, p_m, and p_d, M makes product recommendations to consumers;[6] and (v) consumers draw their switching cost s, receive product recommendations, and observe the prices, after which they make purchase decisions.

Notably, in the baseline model, neither M nor S can credibly commit to a pure role at the beginning of the game. Thus, M always provides the marketplace and procures from S depending on the wholesale price; S always offers a wholesale price and joins the marketplace. In Section 4.1, we let M have the ability to commit to a business model (marketplace, reseller, or no commitment) upfront and study the conditions under which M wants to commit to a specific business model. In Section A.1, we allow S to have the ability to commit to a seller mode (wholesaler, retailer, or no commitment) upfront and examine S's incentive to commit.

Table 1 summarizes the key parameters and decision variables of the baseline model.

[5]In the baseline model, allowing S to set w before M sets f yields the same equilibrium outcomes as simultaneous timing. Moreover, the main findings continue to hold under fee-first timing, in which M sets f before S sets w.

[6]The platform's (in)ability to observe the direct price when making recommendations does not change the baseline analysis because the platform always recommends its own product to consumers first, as we discuss later.

Table 1: Summary of parameters and decision variables

Notation	Definition and Role in the Model
Parameters	
v	Consumers' valuation for the product
c	Supplier's marginal cost to produce the product
$G(\cdot)$	CDF of consumers' switching cost
$H(\cdot)$	CDF of consumer demand
μ	Upper bound of consumers' switching cost
$\underline{q}, \bar{q}$	Lower and upper bounds of consumer demand
θ	Mean of consumer demand
δ	Half-width of the distribution of consumer demand
Decision Variables	
f	Platform's transaction fee
w	Supplier's wholesale price
q_m	Platform's procurement quantity
p_{resale}	Platform's resale price
p_m	Supplier's retail price on the marketplace
p_d	Supplier's retail price in the direct channel

3.2 Baseline analysis

In this section, we use backward induction to solve for the subgame-perfect Nash equilibrium (SPNE). We begin with the consumers' purchase decisions, then solve for the equilibrium retail pricing and recommendation strategies, next determine M's procurement quantity, and finally characterize M's transaction fee and S's wholesale price.

Consumers' purchase decision. After joining the platform, consumers who receive the recommendation for M's product only observe the resale price p_{resale} and do not know of the existence of S on the platform or in the direct channel. As a result, they purchase M's product if and only if the resale price does not exceed their valuation, i.e.,

$$v \geq p_{resale}.$$

Consumers who receive the recommendation for S's product observe the product prices on the marketplace p_m and in the direct channel p_d. Each buyer draws a switching cost (disutility) s from $G(s)$ and purchases one unit of S's product from the direct channel if and only if direct purchase derives higher utility than staying on the platform:

$$v - p_d - s \geq \max\{v - p_m, 0\}.$$

Retail prices and recommendations. The platform M and the supplier S set retail prices in the same stage. Before solving for the optimal prices, we eliminate weakly dominated strategies and present the conditions that the optimal prices, transaction fee, S's entry decision and M's recommendation mechanism must satisfy in the following lemma (proof is in the appendix).

Lemma 1. *S's optimal prices and M's optimal resale price and transaction fee satisfy $p_m = p_{resale} = v$, $v - \mu \leq p_d \leq v$, and $0 < f \leq v - c$. Moreover, S always enters the marketplace and M always prioritizes its own product when making recommendations.*

Since the consumer demand can fall below M's procurement and the unsold inventory cannot generate any value for M, the procurement cost is sunk at the time when M makes product recommendations. Consequently, by charging $p_{resale} = v$ and recommending its own product to consumers, M's marginal profit is v. In contrast, the profit from recommending S's product is f multiplied by the probability of an on-platform transaction, which is less than v as $f \leq v - c$. As a result, when realized demand falls below M's procurement quantity, M exclusively recommends its own product. Conversely, when demand exceeds the procurement quantity, M prioritizes its own product to meet demand up to the inventory limit, and then recommends S's product to serve the residual demand. Steering recommendations insulates the platform's reseller function from retail competition with the supplier, so S charges $p_m = v$ to maximize its profit.

Given $p_m = p_{resale} = v$, S sets the direct price to maximize its total profit from selling the product to M and to consumers, including sales on the marketplace and in the direct channel:

$$\pi(p_d) = q_m(w - c) + \int_{q_m}^{\bar{q}} (q - q_m)((p_d - v + f)l(p_d) + v - c - f)dH(q), \tag{1}$$

where

$$l(p_d) = G(v - p_d),$$

is the probability of leakage conditional on a consumer receiving the recommendation for S's product.[7] Intuitively, when p_d is higher, consumers are more likely to stay on M and therefore the leakage proportion decreases. In particular, if S charges $p_d = v$, no consumer will switch to the direct channel.

Given S's profit function, the first-order condition (FOC) yields:

$$p_d(f) = v - f + \frac{G(v - p_d(f))}{g(v - p_d(f))}. \tag{2}$$

[7] $G(\cdot)$ is the CDF of consumers' switching cost and $g(\cdot)$ is the corresponding PDF.

For analytical tractability, we assume $G(\cdot)$ is log-concave throughout the remainder of this paper. Under this assumption, the FOC yields a unique, interior profit-maximizing direct price ($p_d(f) < v$) for any $f > 0$.[8] Consequently, M cannot eliminate leakage simply by charging a positive transaction fee. Furthermore, for any $f > 0$, $p_d(f)$ is decreasing in f. As established in Lemma 1, S's optimal direct price is bounded below by $v - \mu$. Therefore, S's profit-maximizing direct price is given by:

$$p_d^*(f) = \max\{p_d(f), v - \mu\}. \tag{3}$$

The procurement quantity. Given the optimal direct price above and the optimal retail prices characterized in Lemma 1, M chooses the procurement quantity q_m to maximize its profit, which consists of two components: the profit made from reselling the product as a reseller and that from charging the transaction fee as a marketplace. Specifically,

$$\Pi(q_m) = \begin{cases} q_m(v-w) + \int_{\underline{q}}^{\bar{q}} (q - q_m)\varphi(f)dH(q) & \text{if} \quad q_m \le \underline{q} \\ \int_{\underline{q}}^{q_m} qvdH(q) + \int_{q_m}^{\bar{q}} q_m v + (q-q_m)\varphi(f)dH(q) - q_m w & \text{if} \quad \underline{q} \le q_m \le \bar{q} \end{cases}, \tag{4}$$

where

$$\varphi(f) \equiv (1 - l(p_d^*(f)))f$$

is M's marketplace margin from recommending S's product, and $p_d^*(f)$ is as specified in equation (3).[9] If $q_m \le \underline{q}$, M's procurement quantity is lower than the minimal consumer demand and therefore M can always sell out its entire inventory. If $q_m > \underline{q}$, M faces the risk that it cannot sell out its inventory when the realized consumer demand is lower than the procurement quantity.

By solving M's profit maximization problem, we obtain the optimal procurement quantity

$$q_m^*(f, w) = \begin{cases} 0 & \text{if} \quad w > v - \varphi(f) \\ H^{-1}\left(1 - \frac{w}{v - \varphi(f)}\right) & \text{if} \quad w \le v - \varphi(f) \end{cases}. \tag{5}$$

Thus, M procures a positive quantity when the resale margin $v - w$ exceeds the marketplace margin $\varphi(f)$. Moreover, M faces no demand risk if $q_m \le \underline{q}$. In particular, if $w = v - \varphi(f)$, M is indifferent among $q_m \in [0, \underline{q}]$. However, to rule out potential non-existence of equilibrium, M's optimal procurement quantity must satisfy $q_m^*(f, v - \varphi(f)) = H^{-1}(0) = \underline{q}$. We will

[8] If $G(\cdot)$ is log-concave, then $\frac{G(v-p_d)}{g(v-p_d)}$ is decreasing in p_d and $\lim_{p_d \to v} \frac{G(v-p_d)}{g(v-p_d)} = 0$.

[9] Throughout this paper, M's marketplace margin refers to the expected profit M makes from recommending S's product to one consumer and charging the transaction fee with the consideration of potential leakage.

discuss the details when solving for S's optimal wholesale price.

Thus, M's optimal procurement quantity is at least $\underline{q}$ if $w \leq v - \varphi(f)$. If $q_m > \underline{q}$, M faces the risk that the realized demand is lower than its procurement quantity. Consequently, when $w \leq v - \varphi(f)$, M's optimal procurement quantity results from a trade-off between the higher resale margin and the risk of excess procurement, and $v - \varphi(f)$ can be considered as the reservation wholesale price such that M is willing to procure the risk-free quantity ($\underline{q}$). Intuitively, M's optimal procurement quantity is decreasing in the wholesale price and its marketplace margin. For brevity, we suppress the arguments and write φ to denote $\varphi(f)$ and q_m^* to denote $q_m^*(f, w)$ in subsequent analysis.

The transaction fee. Given the expressions of optimal retail prices and procurement quantity, M sets a transaction fee f to maximize its total profit without observing the wholesale price

$$\Pi(f) = \begin{cases} \int_{\underline{q}}^{\bar{q}} q\varphi dH(q) & \text{if} \quad w > v - \varphi \\ \int_{\underline{q}}^{q_m^*} qv dH(q) + \int_{q_m^*}^{\bar{q}} q_m^* v + (q - q_m^*)\varphi dH(q) - q_m^* w & \text{if} \quad w \leq v - \varphi \end{cases}. \tag{6}$$

By solving M's profit maximization problem, we can show that M's optimal transaction fee maximizes its marketplace margin, that is,

$$f^* \in \arg\max_f (1 - l(p_d^*(f)))f.$$

Thus, we obtain the following preliminary result (proof is in the appendix).

Lemma 2. *M's profit-maximizing transaction fee maximizes its marketplace margin and induces partial leakage.*

Since M sets the transaction fee and S sets the wholesale price at the same stage, the transaction fee matters only when M recommends S to consumers. As a result, M's optimal transaction fee always maximizes the profit it makes from recommending S to one consumer. Notice that $l(p_d^*(f)) = 0$ only if $f = 0$. Therefore, M's optimal transaction fee is strictly positive and induces partial leakage (i.e., $0 < l(p_d^*(f^*)) < 1$). This result aligns with Hagiu and Wright (2024), whose analysis mainly focuses on the case of uniformly distributed switching costs.

The wholesale price. Given the expressions of optimal retail prices and procurement quantity, S sets a wholesale price w to maximize its total profit without observing the

transaction fee

$$\pi(w) = \begin{cases} \int_{\underline{q}}^{\bar{q}} q\psi(f)dH(q) & \text{if} \quad w > v - \varphi \\ q_m^*(w-c) + \int_{q_m^*}^{\bar{q}} (q - q_m^*)\psi(f)dH(q) & \text{if} \quad w \leq v - \varphi \end{cases}, \tag{7}$$

where

$$\psi(f) \equiv (v - c - f)(1 - l(p_d^*(f))) + (p_d^*(f) - c)l(p_d^*(f))$$

is the expected profit that S makes from selling the product to a consumer and it is decreasing in f. Where no confusion arises, we will omit the argument f and refer to $\psi(f)$ as ψ. Since M charges $f > 0$ and therefore induces positive leakage, we have

$$v - \varphi > \psi + c. \tag{8}$$

Intuitively, since some consumers purchase in the direct channel and gain positive surplus, the total profit that M and S make from the marketplace sales $(\varphi + \psi)$ is lower than the total surplus $(v - c)$. Thus, we obtain the following inequality

$$q_m^*(v - \varphi - c) + \int_{q_m^*}^{\bar{q}} (q - q_m^*)\psi dH(q) \geq \int_{\underline{q}}^{\bar{q}} q\psi dH(q), \tag{9}$$

where the LHS is S's total profit by charging $w = v - \varphi$ and the RHS is that by charging $w > v - \varphi$. Therefore, S never charges $w > v - \varphi$ in equilibrium. Moreover, if consumer demand is always strictly positive (i.e., $\underline{q} > 0$), the above inequality holds with strict inequality. In this case, S's optimal wholesale price satisfies $w^* \leq v - \varphi$ and therefore incentivizes M to procure a strictly positive quantity for resale. Moreover, we can show that even if $\underline{q} = 0$, S's optimal wholesale price satisfies $w^* < v - \varphi$ and thus M also wants to procure a strictly positive quantity.

Recall that we specified $q_m^*(f, v - \varphi) = \underline{q}$ when characterizing M's optimal procurement. Suppose instead that $q_m^*(f, v - \varphi) < \underline{q}$. Equation (8) implies that S's profit may be strictly increasing in w over $[0, v - \varphi)$ and have a downward jump at $w = v - \varphi$. In this case, S's profit supremum cannot be attained, and the optimal wholesale price and equilibrium do not exist. Setting $q_m^*(f, v - \varphi) = \underline{q}$ rules out this discontinuity and allows the boundary price $w^* = v - \varphi$ to be optimal. This tie-breaking rule matters only for the boundary case and does not affect equilibria with $w^* < v - \varphi$.

In addition, given equation (5), M's procurement quantity is less than $\bar{q}$ since $w > 0$. We state that M adopts the hybrid mode if $0 < q_m < \bar{q}$, implying that it operates as both a marketplace and a reseller ex-ante. Relegating the details of the proof to the appendix, we

obtain the following proposition.

Proposition 1. *Under marketplace leakage and demand uncertainty, M adopts the hybrid mode in equilibrium. M's optimal transaction fee maximizes its marketplace margin and the optimal procurement quantity satisfies*

$$q_m^*(f, w) = H^{-1}\left(1 - \frac{w}{v - \varphi(f)}\right).$$

As we mentioned earlier, a sufficient condition for this proposition to hold is that $G(\cdot)$ is log-concave. In equilibrium, M procures a positive quantity when the resale margin $v - w^*$ exceeds the marketplace margin $\varphi(f^*)$. Throughout this paper, we show when this inequality holds and how it changes with consumers' leakage propensity, demand uncertainty, transaction benefits, and supplier competition. Conceptually, the hybrid mode is an ex-ante designation, defined by the existence of demand states in which M operates as both a marketplace and a reseller. Specifically, M procures a positive quantity and sells that inventory first, resorting to S's marketplace listing only when realized demand exceeds its inventory. Therefore, when $q \leq q_m^*$, M behaves as a reseller; when $q > q_m^*$, M clears its own inventory before deploying its recommendation to route residual consumers to S on the marketplace.

The optimality of the hybrid platform mode relies on two critical determinants: marketplace leakage and uncertainty of consumer demand. On the one hand, marketplace leakage undermines the viability of a pure marketplace strategy; M can mitigate leakage and earn more profits by adopting the reseller mode. On the other hand, demand uncertainty constrains M from operating as a pure reseller. The reseller mode facilitates full surplus extraction because it allows M to price the product at consumers' valuation. Consequently, M and S jointly capture the entire surplus, avoiding the welfare losses caused by switching costs. Thus, S can always find an appropriate wholesale price such that both M and S benefit from the reseller mode. However, demand uncertainty introduces inefficiency: the risk of inventory overstocking. When M procures more from S, acting more like a reseller, the probability of overstocking increases. Therefore, M's equilibrium procurement quantity must balance the benefit of surplus extraction from the reseller mode against the risk of excessive inventory, which ultimately induces M to adopt the hybrid mode. In the absence of leakage, M could simply set the transaction fee equal to $v - c$, thereby extracting the entire surplus as a pure marketplace; in the absence of demand uncertainty, M would maximize profits as a pure reseller, exploiting the higher resale margin without the threat of excessive inventory. Finally, we provide conditions under which the equilibrium outcomes are unique and relegate the details to Section A.5 (proof of Proposition 1).

3.3 Comparative statics

In this section, we assume that consumer demand and switching costs are uniformly distributed to derive closed-form expressions for the equilibrium outcomes. Then we provide further economic insights through comparative statics. Specifically, we assume $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\underline{q}}{\bar{q}-\underline{q}}$.

Given uniform distributions, S's optimal direct price is

$$p_d^*(f) = \max\left\{v - \frac{f}{2}, v - \mu\right\}.$$

If M charges a transaction fee greater than 2μ, S will set a direct price that induces full leakage and hence M will make zero profit as a marketplace. Thus, charging any $f > 2\mu$ is a weakly dominated strategy for M and hence we restrict our attention to the case where $f \leq 2\mu$ in this section.

Given the expression of $p_d^*(f)$, M's optimal procurement quantity is

$$q_m^* = \begin{cases} 0 & \text{if} \quad w > v - \varphi \\ \frac{w}{v-\varphi}\underline{q} + \left(1 - \frac{w}{v-\varphi}\right)\bar{q} & \text{if} \quad w \leq v - \varphi \end{cases}, \tag{10}$$

where $\varphi = f - \frac{f^2}{2\mu}$. Thus, M's optimal procurement quantity is a weighted average of $\underline{q}$ and $\bar{q}$, where the weighting terms depend on f and w. Since M's optimal transaction fee maximizes φ and is capped by $v - c$, we obtain

$$f^* = \min\{\mu, v - c\}. \tag{11}$$

Based on equation (7), we solve S's profit maximization problem and obtain the optimal wholesale price

$$w^* = \min\left\{\frac{\bar{q}(v-\varphi) + (\bar{q}-\underline{q})c}{(\bar{q}-\underline{q})\left(2 - \frac{\psi}{v-\varphi}\right)}, v - \varphi\right\}, \tag{12}$$

where $\psi = v - c - f + \frac{f^2}{4\mu}$.

Combining equations (11) and (12), we solve for the equilibrium wholesale price. To facilitate the comparative statics analysis with respect to demand factors, we denote $\underline{q} = \theta - \delta$ and $\bar{q} = \theta + \delta$, where θ is the mean of consumer demand and δ measures the uncertainty of consumer demand, i.e., $H(q) = \frac{q-\theta+\delta}{2\delta}$. Moreover, we define consumers' leakage propensity as the reciprocal of the switching cost parameter (i.e., $\frac{1}{\mu}$). Relegating the details of the proof to the appendix, we obtain the following proposition.

Proposition 2. *Suppose* $G(s) = \frac{s}{\mu}$ *and* $H(q) = \frac{q-\theta+\delta}{2\delta}$. *M adopts the hybrid mode in equilibrium. Moreover, the equilibrium procurement quantity is*

$$q_m^*(f^*, w^*) = \begin{cases} \max\left\{\frac{(\mu+4c)\theta+(\mu-4c)\delta}{4v+4c-\mu}, \theta-\delta\right\} & \text{if} \quad \mu \leq v-c \\ \max\left\{\frac{\theta-\delta}{2} - \frac{(v-c)^2(\theta-5\delta)}{2(3(v-c)^2+8\mu c)}, \theta-\delta\right\} & \text{if} \quad \mu \geq v-c \end{cases}.$$

M's procurement quantity may be increasing or decreasing in demand uncertainty (δ). *Notably, if* $\frac{\delta}{\theta} > \frac{v+c}{2v}$, *M's procurement quantity is strictly increasing in leakage propensity for* $\frac{1}{\mu} \in \left[\frac{2c(\theta-\delta)}{(v-c)^2(2\delta-\theta)}, \frac{1}{v-c}\right]$ *and strictly decreasing in leakage propensity for* $\frac{1}{\mu} \in \left[\frac{1}{v-c}, \frac{\theta}{2v(\theta-\delta)}\right]$.[10]

When demand uncertainty is sufficiently high such that $\frac{\delta}{\theta} > \frac{v+c}{2v}$, the equilibrium procurement quantity exhibits an inverted-U shape. Importantly, when consumers' leakage propensity is relatively strong such that $\frac{1}{v-c} \leq \frac{1}{\mu} \leq \frac{\theta}{2v(\theta-\delta)}$, M's equilibrium procurement quantity q_m^* is *strictly decreasing* in consumers' leakage propensity. That is, the platform's business model shifts toward the marketplace mode in response to a worsening leakage problem. As shown in Figure 1, the equilibrium procurement q_m^* is first increasing then decreasing in leakage propensity $\frac{1}{\mu}$, and the kink point is $\mu = v - c$.

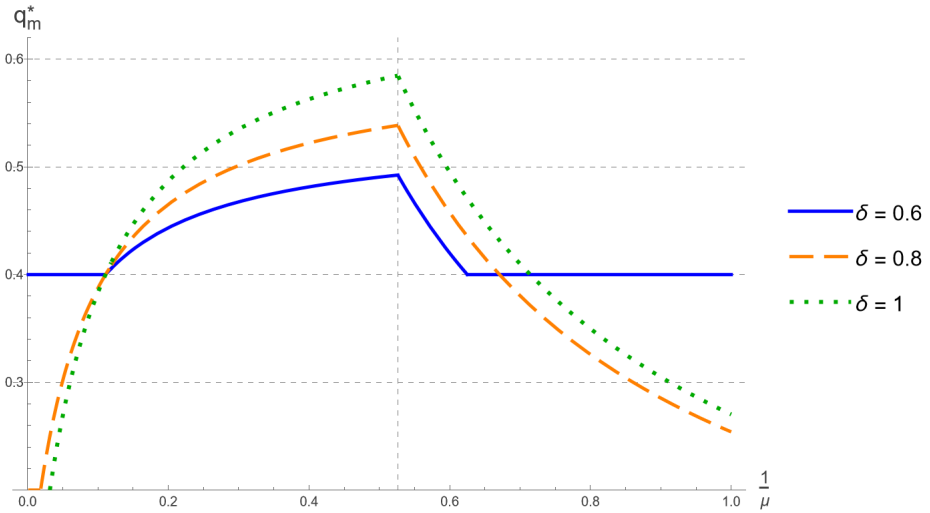


Figure 1: Procurement quantity (q_m^*) versus leakage propensity ($1/\mu$) under demand uncertainty (δ)
($v = 2, \theta = 1, c = 0.1$)

To understand this non-monotonic pattern, we discuss the underlying economic intuition as follows. As consumers' leakage propensity ($\frac{1}{\mu}$) increases, two countervailing forces emerge. On the one hand, a worsening leakage problem reduces M's marketplace margin. This decline in profitability of the marketplace mode incentivizes M to procure more and move toward

[10] When $\theta = \delta$, the interval is unbounded above.

the reseller mode. On the other hand, greater leakage propensity boosts S's profitability as a retailer and empowers S to charge a higher wholesale price, which compresses M's resale margin, driving it to procure less and shift toward the marketplace mode. Thus, whether M expands or shrinks its reseller operation depends on which of these two margins deteriorates faster.

Importantly, this inverted-U pattern is driven by a fundamental shift in S's incentive to raise the wholesale price. For illustration, we assume $\theta = \delta$ such that the equilibrium procurement is never bounded below by $\underline{q}$ for following discussion. When the leakage problem is relatively mild ($\frac{v-c}{\mu} \leq 1$), M does not need to control leakage by lowering the transaction fee, which is reflected by the fact that M's optimal transaction fee is capped at $v - c$ as $f^* = \min\{\mu, v - c\}$. In this regime, S benefits from more consumers switching to the direct channel but its profitability on the marketplace remains unchanged. However, once consumers' leakage propensity crosses the threshold ($\frac{v-c}{\mu} \geq 1$), M is forced to prevent excessive leakage by strategically lowering the transaction fee. Notably, this mechanism creates a "double benefit" for S as a retailer: it not only capitalizes on consumers' higher willingness to switch to the direct channel, but it also enjoys a lower transaction fee for selling on the marketplace. Thus, when $\frac{v-c}{\mu} \geq 1$, the "double benefit" as a retailer makes S less reliant on the wholesale channel and more incentivized to raise the wholesale price. Consequently, as $\frac{1}{\mu}$ increases, S raises the wholesale price drastically, which severely compresses M's resale margin and forces M to reduce its procurement quantity. In Section A.6 (proof of Proposition 2), we provide a more detailed discussion of this inverted-U pattern.

4 Extensions

The five extensions map the boundaries of our mechanism. The first studies conditions under which the platform benefits from upfront commitment to a pure business model (Section 4.1). The next two establish robustness: the hybrid model survives when the wholesale and retail functions are separated across independent suppliers (Section 4.2) and when the supplier can partially insure the platform through a costly return policy (Section 4.3). The remaining results identify boundary conditions under which the platform abandons the hybrid mode without making an upfront commitment. Specifically, the platform shifts to a pure marketplace mode when it can provide on-platform transaction benefits at a sufficiently low cost (Section 4.4) or when supplier competition is fierce (Section 4.5), and it reverts to a pure reseller mode when returns are costless for the supplier (Section 4.3).

4.1 Business model commitment

In the baseline model, M's business model emerges from its procurement decision after observing the wholesale price, without an upfront commitment to a particular mode. In this section, we introduce a stage 0 before M and S set the transaction fee and wholesale price, in which M can credibly commit to operating exclusively as a marketplace or a reseller, or choose not to commit. Pure-marketplace commitment rules out procurement, whereas pure-reseller commitment closes the marketplace and prevents leakage to S's direct channel. As a pure reseller, M continues to choose its procurement quantity optimally. Once its inventory is exhausted, no product is available for recommendation, and the remaining demand is unserved. The baseline model is otherwise unchanged.

We first show that M never strictly benefits from committing to a pure marketplace. Such a commitment makes S's wholesale price irrelevant and leaves S's retail-pricing problem unchanged. Therefore, M continues to choose the transaction fee that maximizes its marketplace margin as in the baseline. We use f^* to denote this fee, and write $\varphi^* = \varphi(f^*)$ and $\psi^* = \psi(f^*)$ for brevity. Moreover, we use $q^{**}_{m,H}$ and Π^*_H to denote baseline procurement and platform profit in equilibrium, where the subscript H denotes the hybrid model. The platform's expected profit under pure-marketplace commitment is $\Pi^*_M = \int_{\underline{q}}^{\bar{q}} \varphi^* q dH(q) = \varphi^* \mathbb{E}[q]$. Based on equation (5), substituting $w^*_H = (v - \varphi^*)[1 - H(q^{**}_{m,H})]$ into M's profit gives

$$\Pi^*_H = \varphi^* \mathbb{E}[q] + (v - \varphi^*) \int_{\underline{q}}^{q^{**}_{m,H}} q dH(q) \geq \varphi^* \mathbb{E}[q] = \Pi^*_M. \tag{13}$$

The inequality is strict when $q^{**}_{m,H} > \underline{q}$ and becomes an equality when procurement equals minimum demand. Thus, retaining the option to procure weakly improves M's equilibrium profit. We consequently focus on the comparison between pure-reseller commitment and no commitment.

Under pure-reseller commitment, the marketplace is shut down and therefore M loses its marketplace revenue. The commitment also eliminates S's retail profit because consumers cannot discover its direct channel without recommendations from M. M sets its resale price equal to v and chooses procurement $q_{m,R}$ to maximize

$$\Pi_R = v \int_{\underline{q}}^{\bar{q}} \min\{q, q_{m,R}\} dH(q) - w_R q_{m,R}, \tag{14}$$

where the subscript R denotes pure reseller. Thus, M's optimal procurement quantity is

$$q^*_{m,R}(w_R) = \begin{cases} 0 & \text{if} \quad w_R > v \\ H^{-1}\left(1 - \frac{w_R}{v}\right) & \text{if} \quad w_R \leq v \end{cases}, \tag{15}$$

which is consistent with M's optimal procurement quantity in the baseline (equation (5)) since $\varphi = 0$ under pure-reseller commitment. At $w_R = v$, we retain the baseline tie-breaking rule $q^*_{m,R}(v) = \underline{q}$. By backward induction, S chooses the wholesale price to maximize its profit

$$\pi_R = (w_R - c)q^*_{m,R}(w_R).$$

Similar to the baseline analysis, we assume that switching costs and consumer demand are uniformly distributed to obtain closed-form solutions. Specifically, $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\theta+\delta}{2\delta}$, where $\underline{q} = \theta - \delta$ and $\bar{q} = \theta + \delta$. Under pure-reseller commitment, M's procurement response is

$$q^*_{m,R}(w_R) = \theta + \delta - \frac{2\delta w_R}{v}.$$

Substituting this response into S's profit function and solving the optimization problem over w_R yields the equilibrium wholesale price and procurement quantity

$$w^*_R = \min\left\{v, \frac{v(\theta+\delta)}{4\delta} + \frac{c}{2}\right\},$$
$$q^*_{m,R}(w^*_R) = \max\left\{\theta - \delta, \frac{\theta+\delta}{2} - \frac{c\delta}{v}\right\}.$$

Given the closed-form solutions, we can compare M's equilibrium profits under pure-reseller commitment and without commitment. Relegating the details to the appendix, we obtain the following proposition.

Proposition 3. *Under marketplace leakage and demand uncertainty,*
(i) M never strictly benefits from pure-marketplace commitment;
(ii) assuming $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\theta+\delta}{2\delta}$, if $\frac{\delta}{\theta} > \frac{v}{3v-2c}$, then there exists a unique $\widehat{\mu} \in (0, v-c)$ such that M strictly prefers pure-reseller commitment if and only if $\mu < \widehat{\mu}$.

Committing to a pure reseller can be beneficial for M when leakage is sufficiently severe and demand is sufficiently uncertain. When consumers' leakage propensity is low, M earns a high marketplace margin and therefore shutting down the marketplace is costly. As leakage intensifies, M's marketplace margin declines, while S's retail sales become more profitable, strengthening its incentive to charge a high wholesale price. In this case, pure-reseller commitment eliminates S's retail alternative, thereby inducing a lower wholesale price. When

leakage is sufficiently severe, the resulting benefit to M outweighs the loss of marketplace revenue. Moreover, demand uncertainty is also essential. If demand uncertainty is sufficiently low and M commits to a pure reseller, S optimally charges $w_R^* = v$ and extracts all surplus from the minimum-demand quantity, leaving M zero profit. Sufficiently high demand uncertainty instead induces S to lower its wholesale price, which encourages procurement and leaves M a positive profit. Thus, pure-reseller commitment is attractive only when demand uncertainty is sufficiently high and leakage is sufficiently severe.

Figure 2 shows M's equilibrium procurement when upfront commitment is possible. When $\frac{\delta}{\theta} > \frac{v+c}{2v}$, baseline procurement exhibits an inverted-U pattern in consumers' leakage propensity. Even with the commitment option, procurement remains strictly decreasing in leakage propensity over the interval $\max\{\widehat{\mu}, \frac{2v(\theta-\delta)}{\theta}\} \leq \mu \leq v-c$. This interval is nonempty because both $\widehat{\mu}$ and $\frac{2v(\theta-\delta)}{\theta}$ are strictly below $v - c$.

In Section A.1, we examine the case in which S can commit upfront to operating exclusively as a wholesaler or a retailer, while M cannot make a commitment. We show that S never strictly benefits from committing to pure retail and prefers pure-wholesaler commitment when consumers' leakage propensity is sufficiently low.

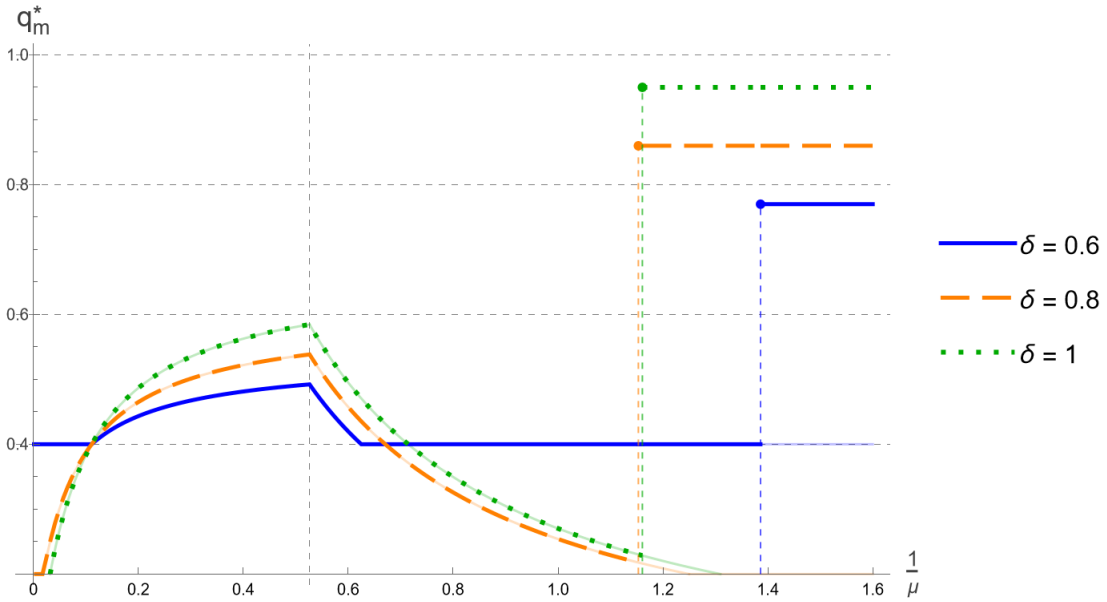


Figure 2: Platform commitment: equilibrium procurement (q_m^*) versus leakage propensity ($1/\mu$) under demand uncertainty (δ)
($v = 2, \theta = 1, c = 0.1$)

4.2 Independent suppliers

In this section, we analyze a scenario where the platform faces a pure wholesaler and a pure retailer rather than an integrated supplier. The wholesaler S_1 only sells to the platform and the retailer S_2 only sells to consumers either through the platform's marketplace or its own channel. Thus, S_1 sets a wholesale price (w) and S_2 sets the retail prices on M's marketplace (p_m) and in the direct channel (p_d). As in the baseline, consumers prefer transacting on M and face a switching cost (disutility) s when buying directly from S_2, which is drawn from a distribution $G(s)$ over the interval $[0, \mu]$. We assume that the wholesaler's marginal cost is weakly lower than that of the retailer (i.e., $c_w \leq c_r$). Then the baseline model is otherwise unchanged, including the consumer demand and timeline. Importantly, we show that most results and insights from the baseline analysis are preserved when suppliers are not integrated, but the comparative statics under uniform distributions change.

Intuitively, M does not care whether the suppliers are independent or not, so the optimal procurement quantity and transaction fee remain the same as in the baseline. Moreover, S_2's optimal price on the platform (p_m) is still equal to consumers' valuation and its optimal direct price maximizes its profit from selling the product to consumers given the transaction fee, which is also unchanged relative to the baseline. Following the same logic as in the proof of Lemma 1, we obtain the following lemma.

Lemma 3. *The suppliers' optimal prices and M's optimal resale price and transaction fee satisfy $p_m = p_{resale} = v$, $v - \mu \leq p_d \leq v$, and $0 < f \leq v - c_r$. Moreover, M always prioritizes its own product when making recommendations.*

Given the expression of M's optimal procurement quantity, the wholesaler S_1's profit function is

$$\pi_1(w) = \begin{cases} 0 & \text{if} \quad w > v - \varphi \\ q_m^*(w - c_w) & \text{if} \quad w \leq v - \varphi \end{cases},$$

where $v - \varphi \geq v - f \geq c_r$. Since $c_w \leq c_r$, S_1 can set a wholesale price $w \in (c_w, v - \varphi)$ and make a strictly positive profit. Thus, we obtain the following result.

Proposition 4. *Under marketplace leakage and demand uncertainty, if the wholesaler has a lower marginal cost, M adopts the hybrid mode in equilibrium.*

Unlike the baseline results, the above proposition holds even if $G(\cdot)$ is not log-concave, meaning that the platform adopts the hybrid mode under weaker conditions when suppliers are independent than when facing an integrated supplier. In the baseline model, the integrated supplier retains the option of selling to consumers, whereas the independent wholesaler

has no such outside option. Thus, the independent wholesaler must set a price at which the platform procures a positive quantity.

Similar to the baseline analysis, we study the comparative statics by assuming that consumers' demand and switching costs are uniformly distributed. Specifically, $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\theta+\delta}{2\delta}$. Since the optimal retail prices and transaction fee remain the same as in the baseline, we only show the equilibrium wholesale price and procurement quantity in the following proposition.

Proposition 5. *Suppose $G(s) = \frac{s}{\mu}$, $H(q) = \frac{q-\theta+\delta}{2\delta}$, and $c_w \leq c_r$. In equilibrium, M adopts the hybrid mode, and the equilibrium wholesale price and procurement quantity are as follows:*

$$w^* = \begin{cases} \min\left\{\frac{(\theta+\delta)\left(v-\frac{\mu}{2}\right)}{4\delta} + \frac{c_w}{2}, \frac{2v-\mu}{2}\right\} & \text{if} \quad \mu \leq v - c_r \\ \min\left\{\frac{(\theta+\delta)\left((v-c_r)^2+2\mu c_r\right)}{8\mu\delta} + \frac{c_w}{2}, \frac{(v-c_r)^2+2\mu c_r}{2\mu}\right\} & \text{if} \quad \mu > v - c_r \end{cases},$$

$$q_m^*(f^*, w^*) = \begin{cases} \max\left\{\frac{\theta+\delta}{2} - \frac{2\delta c_w}{2v-\mu}, \theta - \delta\right\} & \text{if} \quad \mu \leq v - c_r \\ \max\left\{\frac{\theta+\delta}{2} - \frac{2\mu\delta c_w}{2\mu c_r+(v-c_r)^2}, \theta - \delta\right\} & \text{if} \quad \mu > v - c_r \end{cases}.$$

In response to an increase in leakage propensity ($\frac{1}{\mu}$), S_1's wholesale price and M's procurement quantity increase; in response to an increase in demand uncertainty (δ), S_1's wholesale price decreases and M's procurement quantity may increase or decrease.

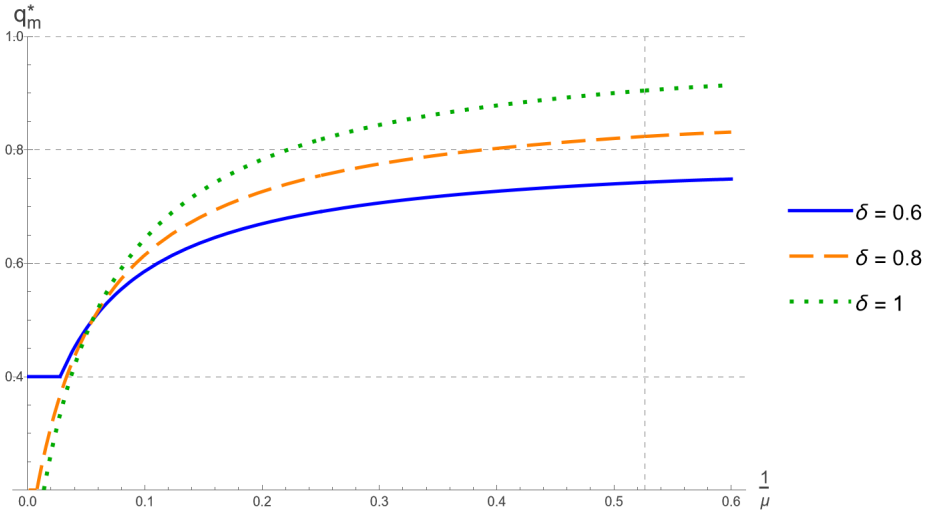


Figure 3: Independent suppliers: procurement quantity (q_m^*) versus leakage propensity ($1/\mu$) under demand uncertainty (δ)
($v = 2, \theta = 1, c_w = c_r = 0.1$)

As shown in Figure 3, M's equilibrium procurement quantity facing independent suppliers is monotonically increasing in consumers' leakage propensity, even within the range

$\frac{v-c_r}{\mu} \geq 1$, which deviates from the baseline results in Figure 1. This divergence arises because the wholesale price is endogenous and the independent wholesaler lacks the outside option of selling directly to consumers, which is available to the integrated supplier in the baseline. As leakage propensity increases, the diminishing marketplace margin lowers M's opportunity cost of procurement, thereby inducing an upward shift in M's demand for procurement. Consequently, the independent wholesaler raises the wholesale price solely as a demand-driven response. In contrast, in the baseline model, the integrated supplier raises the wholesale price sharply because stronger leakage propensity enhances its profitability both in the direct channel and on M's marketplace (the "double benefit" effect). Thus, the independent wholesaler's incentive to raise the wholesale price in response to increasing leakage propensity is weaker than that of the integrated supplier. This mitigated price response ultimately drives the monotonically increasing pattern of the equilibrium procurement quantity.

In response to an increase in leakage propensity, M's procurement quantity is strictly higher when facing independent suppliers than under the baseline. This is driven by the differences in market power: the independent wholesaler, who lacks the outside option of consumer sales, entirely relies on sales to M and is compelled to charge a lower wholesale price to stimulate M's demand for procurement. In contrast, the integrated supplier can sustain a higher wholesale price by leveraging its ability to sell the product to consumers. Consequently, M optimally procures a larger quantity when facing independent suppliers.

4.3 Supplier's return policy

In this section, we assume the supplier can set a maximum return quantity along with the wholesale price. Thus, the platform chooses its procurement quantity after observing the wholesale price w and the return quantity q_r. If the consumer demand is lower than the platform's procurement quantity (i.e., $q < q_m$), then the platform can return at most q_r units of the product to the supplier and receive a full refund of w for each unit of returned product. Moreover, S can sell the returned product in an outside channel and receive βc for each unit. We assume $0 \leq \beta \leq 1$ so that S cannot make positive profit from the outside channel. To obtain analytical results, we further assume that consumers' demand is uniformly distributed, specifically, $H(q) = \frac{q}{\bar{q}}$. Furthermore, we can show that M still first recommends its own product in equilibrium, and M's optimal resale price and S's optimal retail price on the marketplace are still equal to consumers' valuation. In addition, S's optimal direct price is also the same as that solved in the baseline model.

By solving M's profit maximization problem, we obtain the optimal procurement quantity

$$q_m^*(f, w, q_r) = \begin{cases} 0 & \text{if} \quad w > v - \varphi \\ \frac{w}{v-\varphi} q_r + \left(1 - \frac{w}{v-\varphi}\right) \bar{q} & \text{if} \quad w \leq v - \varphi \end{cases}, \tag{16}$$

where q_r is the maximal return quantity chosen by S. For brevity, we suppress the arguments and write q_m^* to denote $q_m^*(f, w, q_r)$ in this section. Notice that M will procure the highest consumer demand ($q_m^* = \bar{q}$) if $q_r = \bar{q}$, as the risk of excessive inventory is fully insured by S's return policy, so S has no incentive to offer a return quantity greater than $\bar{q}$. Moreover, M will procure nothing if $w > v - \varphi$, which follows the same logic as in the baseline. Thus, we eliminate the weakly dominated strategies and focus on the case in which $q_r \leq \bar{q}$ and $w \leq v - \varphi$ for subsequent analysis in this section. In addition, M's optimal transaction fee is also the same as in the baseline model.

Given the expression of M's optimal procurement quantity, S sets $w \leq v - \varphi$ and $q_r \leq \bar{q}$ to maximize its total profit without observing the transaction fee

$$\begin{aligned} \pi(w, q_r) = &\int_0^{q_m^* - q_r} (q_m^* - q_r)w + \beta q_r c dH(q) + \int_{q_m^* - q_r}^{q_m^*} qw + \beta(q_m^* - q)c dH(q) \\ &+ \int_{q_m^*}^{\bar{q}} q_m^* w + (q - q_m^*)\psi dH(q) - q_m^* c. \end{aligned} \tag{17}$$

By solving S's optimal wholesale price and return quantity, we obtain the following proposition (proof is in the appendix).

Proposition 6. *Under marketplace leakage and demand uncertainty, suppose $H(q) = \frac{q}{\bar{q}}$. In equilibrium,*
(i) if $\beta = 1$ or $c = 0$, S provides a full return policy ($q_r = \bar{q}$) and M is a pure reseller;
(ii) otherwise, S provides a partial return policy ($0 < q_r < \bar{q}$) and M adopts the hybrid mode.

By offering a full return policy, S eliminates M's inventory risk, which prevents the full procurement and M's adoption of the pure reseller mode in the baseline model. In contrast, a partial return policy leaves M with some residual inventory risk; hence, the rationale for the hybrid business model is preserved.

Consider the extreme case where $\beta = 1$ or $c = 0$, in which S can provide a return policy at no cost. In this scenario, S induces M to operate as a pure reseller by offering a full return policy and setting the wholesale price $w = v - \varphi$. Since the return policy fully mitigates the inventory risk, M remains indifferent between the reseller and marketplace modes, as the marketplace and resale margins are equal. We assume that M adopts the pure reseller mode when it is indifferent; otherwise, S could set a wholesale price equal to $v - \varphi - \varepsilon$ (where ε is

arbitrarily small) to ensure that M's resale margin exceeds its marketplace margin, thereby inducing M to choose the pure reseller mode. Consequently, M's profit is driven down to its minimum, which is exactly the profit level that can be ensured by operating as a pure marketplace. Furthermore, consumer surplus is also minimized, as the pure reseller mode yields zero surplus for consumers. Thus, S maximizes its own profit by setting $q_r = \bar{q}$ and $w = v - \varphi$. Conversely, when $\beta < 1$ and $c > 0$, providing a return policy is costly for S. Because the cost of a full return policy outweighs its benefits, S optimally offers a partial return policy.

4.4 Investment in transaction benefits

One strategy platforms can adopt to reduce leakage is to offer exclusive benefits that consumers cannot obtain when completing transactions in the direct channel.[11] These benefits can increase the perceived value of transacting on the platform and reduce consumers' incentives to switch to the direct channel. In this section, we explore how the platform's ability to invest in transaction benefits affects its choice of the business model.

We model this by assuming that M can provide consumers with a benefit b for completing their transactions on M at a cost of $K(b)$, where $K(\cdot)$ is an increasing and convex function. The benefit b should be interpreted broadly, including loyalty credits, shipping and return privileges, and rebates or coupons conditional on completing the transaction on-platform. Buyers observe b after they join M and their valuation becomes $v + b$ if they purchase M's product or S's product on the marketplace, while their valuation remains at v if they switch to the direct channel. In the first stage of the game, M jointly determines the benefit level and the transaction fee, while S simultaneously sets the wholesale price. The baseline model is otherwise unchanged.

To obtain closed-form solutions, we assume that consumers' switching costs and demand are uniformly distributed and the investment cost is quadratic: $G(s) = \frac{s}{\mu}$, $H(q) = \frac{q}{\bar{q}}$, and $K(b) = \frac{kb^2}{2}$. Additionally, we assume that consumers' switching costs are not too large, such that $\mu \leq v - c$. Following the same logic as in the baseline, we can eliminate weakly dominated strategies and present the conditions that the optimal product prices, transaction fee, and recommendation mechanism must satisfy in the following lemma (proof is in the appendix).

Lemma 4. *S's optimal prices and M's optimal resale price and transaction fee satisfy $p_m = p_{resale} = v + b$, $v - \mu \leq p_d \leq v$, and $b \leq f \leq v + b - c$. Moreover, S always enters the*

[11] For instance, platforms like Amazon and JD.com provide faster shipping and more user-friendly return policies, while Airbnb offers payment protection, dispute mediation, and flexible cancellation policies.

marketplace and M always prioritizes its own product when making recommendations.

Then we solve M's profit maximization problem and obtain the optimal procurement quantity

$$q_m^*(f,b,w) = \begin{cases} 0 & \text{if} \quad w > v+b-\varphi(f,b) \\ \left(1-\frac{w}{v+b-\varphi(f,b)}\right)\bar{q} & \text{if} \quad w \leq v+b-\varphi(f,b) \end{cases}, \tag{18}$$

where $\varphi(f,b) \equiv (1-l(p_d^*(f,b)))f = f - \frac{f(f-b)}{2\mu}$. For a given transaction fee and wholesale price, when M invests more in consumer benefits, the change in the optimal procurement quantity is ambiguous. On the one hand, M's marketplace margin from charging the transaction fee increases as S sets a higher direct price, leading to less leakage. On the other hand, M's resale margin also increases as M can charge a higher resale price. As a result, the overall effect of greater consumer benefits is unclear.

Given the expressions of S's optimal direct price and M's optimal procurement quantity, S's optimal wholesale price is

$$w^*(f,b) = \frac{v+b-\varphi(f,b)+c}{2-\frac{\psi(f,b)}{v+b-\varphi(f,b)}}, \tag{19}$$

where $\psi(f,b) \equiv (v+b-c-f)(1-l(p_d^*(f,b)))+(p_d^*(f,b)-c)l(p_d^*(f,b)) = v-c-(f-b)+\frac{(f-b)^2}{4\mu}$.

Moreover, similar to the baseline analysis, M's optimal transaction fee maximizes its marketplace margin from recommending S's product subject to $f \geq b$, which yields

$$f^*(b) = \begin{cases} b & \text{if} \quad b \geq 2\mu \\ \mu + \frac{b}{2} & \text{if} \quad b \leq 2\mu \end{cases}.$$

Thus, M's problem reduces to choosing the level of consumer benefits that maximizes its profit. Relegating the details of the equilibrium characterization to the appendix, we obtain the following proposition.

Proposition 7. *Suppose $G(s) = \frac{s}{\mu}$, $H(q) = \frac{q}{\bar{q}}$, $K(b) = \frac{kb^2}{2}$, and $\mu \leq v-c$.*
(i) If $k \leq \frac{\bar{q}}{4\mu}$, then M is a pure marketplace in equilibrium, and the equilibrium transaction fee and consumer benefit satisfy

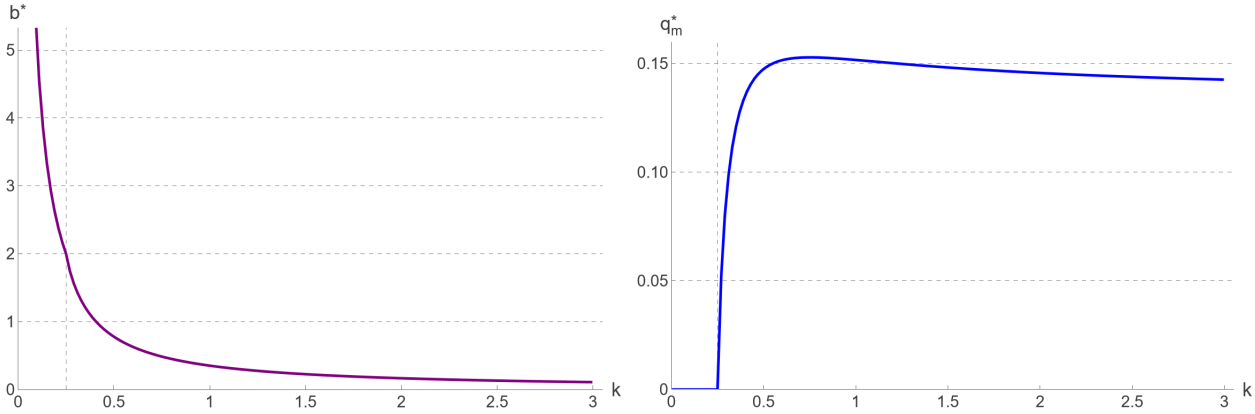
$$f^* = b^* = \frac{\bar{q}}{2k};$$

(ii) If $k > \frac{\bar{q}}{4\mu}$, then M adopts the hybrid mode in equilibrium, and the equilibrium transaction fee and consumer benefit satisfy

$$f^* = \mu + \frac{b^*}{2}, b^* \in (0, 2\mu).$$

Intuitively, when M's investment costs are sufficiently low, it can generate substantial consumer surplus and charge a high transaction fee. In this regime, M seeks to eliminate leakage entirely, as the marginal loss in profit resulting from leakage outweighs the gains from incremental increases in the transaction fee. Consequently, M optimally charges a transaction fee equal to the consumer benefits provided, which serves as an incentive-compatibility constraint ensuring S has no incentive to induce leakage. Since no leakage occurs and S's price on the marketplace fully captures consumer surplus, the marketplace mode achieves efficiency in inventory allocation, allowing M and S to share the entire welfare. Conversely, the reseller mode remains inefficient due to the uncertain demand, which may fall below M's procurement quantity and result in an excessive inventory problem. Given this inefficiency, either M or S must face a loss of profit if M shifts from the pure marketplace mode to the hybrid or pure reseller mode. In other words, S cannot offer a wholesale price that makes S and M mutually benefit from the reseller mode. Thus, in equilibrium, S only sells to consumers, and M functions exclusively as a pure marketplace.

In contrast, as investment costs become significant, M's optimal transaction fee exceeds the consumer benefits, thereby inducing partial leakage. As a result, the resale price can fully capture the transaction benefits while the transaction fee cannot, which makes the reseller mode more efficient. Thus, S responds by offering a wholesale price such that both parties can benefit from the reseller mode. Consequently, M adopts the hybrid mode in equilibrium, balancing the higher resale margin and the risk of excessive procurement.



(a) Transaction benefits b^* versus k

(b) Procurement quantity q_m^* versus k

Figure 4: Benefits (b^*) and procurement (q_m^*) versus investment cost (k)
($v = 2, \bar{q} = 1, \mu = 1, c = 0.1$)

Figure 4 illustrates how the platform's choices of transaction benefits and procurement quantity vary with respect to investment cost. Unsurprisingly, M's investment in transaction benefits is decreasing in cost (Figure 4a). Notably, M's procurement quantity exhibits

a non-monotonic relationship with the investment cost. Two countervailing forces drive this pattern. On the one hand, when the investment cost exceeds the threshold characterized in Proposition 7 (i.e., $k > \frac{\bar{q}}{4\mu}$), M's equilibrium transaction fee induces positive leakage, and the leakage proportion increases as transaction benefits diminish. Consequently, M increases its procurement quantity to mitigate the leakage problem. On the other hand, a decrease in transaction benefits narrows the margin premium of the reseller mode. This margin compression stems from the fact that the resale price fully internalizes the transaction benefits (i.e., $p_{resale} = v + b$), whereas the transaction fee does not (i.e., $f = \mu + \frac{b}{2}$). Thus, diminishing transaction benefits induce M to reduce procurement. Crucially, this second force is modest at lower procurement volumes but becomes increasingly salient as procurement expands; however, the first force works in the exact opposite direction. Specifically, when q_m is small, the marketplace constitutes the primary source of M's profit. Moreover, the leakage problem is particularly severe because a substantial share of consumers receive recommendations for S's product and a fraction of them subsequently switch to the direct channel. Consequently, M possesses a strong incentive to expand procurement to mitigate leakage. Concurrently, because resale contributes to a small share of M's total profit at low levels of q_m, the declining reseller margin premium has a minor impact on M's procurement strategy. Conversely, an entirely reversed logic applies when q_m is large. Thus, the leakage-mitigation effect dominates at lower procurement levels, whereas the margin-shrinking effect prevails at higher volumes, yielding the pattern illustrated in Figure 4b.

4.5 Competing suppliers

In this section, we study the case where the platform faces two integrated suppliers, S_1 and S_2, both of which sell to the platform M and/or directly to consumers. To model the suppliers' competition in their direct channels, we assume that M can observe the prices in both direct channels before it makes product recommendations and can charge supplier-specific transaction fees. If consumers switch to S_i's direct channel, their switching costs are drawn from $G_i(s)$ over $[0, \mu_i]$, where $i \in \{1, 2\}$. We later show that our findings in this part generalize straightforwardly to a setting with N competing suppliers.

The timeline is as follows: (i) M sets the per-unit transaction fees f_1 and f_2, and S_i sets the wholesale price w_i at the same time; (ii) given w_i, M decides the quantity q_{mi} of the product to procure from S_i; (iii) M sets its resale price p_{resale} and S_i sets its retail prices through M's marketplace and in the direct channel: p_{mi} and p_{di} respectively; (iv) the demand q is realized. Upon observing it, M makes product recommendations to consumers; (v) consumers draw their switching costs s, receive product recommendations, and observe

the price(s). Afterwards, consumers make purchase decisions based on the recommendations they receive and the prices they observe.

Similar to the baseline analysis, we assume that consumers' demand and switching costs are uniformly distributed such that $G_i(s) = \frac{s}{\mu_i}$ and $H(q) = \frac{q}{\bar{q}}$. Without loss of generality, we assume that S_1's marginal cost is weakly lower than that of S_2 (i.e., $c_1 \leq c_2$). Then we eliminate weakly dominated strategies and obtain the following lemma (proof is in the appendix).

Lemma 5. *In equilibrium, the retail prices satisfy $p_{m1} = p_{m2} = p_{resale} = v$. M recommends S_1 to consumers after its own inventory is sold out and the optimal transaction fee to S_1 satisfies $f_1 \geq v - c_2$.*

Similar to the baseline model, M's optimal transaction fees maximize the profit it makes from recommending a supplier's product to one consumer. If M charges $f_1 = f_2 = v - c_2$, S_1 and S_2 compete in their direct prices for M's recommendation, because in this case, M recommends the supplier with the lower leakage proportion after its own inventory is sold out. As a result, the equilibrium direct prices will be $p_{d1} = p_{d2} = v$ and induce no leakage, which yields a marketplace margin of $v - c_2$ for M. Since M can ensure a marketplace margin of $v - c_2$ by charging $f_1 = f_2 = v - c_2$ and recommending S_1, and $v - c_2$ is already the highest marketplace margin M can possibly make from recommending S_2, M will only recommend S_1 in equilibrium.[12] Moreover, $v - c_2$ is also the highest marketplace margin M can possibly make from recommending S_1 if the following condition holds:

$$v - c_2 \geq \left(1 - \frac{\min\{\mu_1, v - c_1\}}{2\mu_1}\right) \min\{\mu_1, v - c_1\}, \tag{20}$$

where the RHS is the equilibrium marketplace margin that M makes from recommending S_1 if S_2 does not exist (as in the baseline). Crucially, S_2's marginal cost determines whether M can effectively use S_2 to discipline S_1. When S_2's cost is sufficiently small such that inequality (20) holds, using S_2 to discipline S_1 yields higher profit for M. Therefore, M can charge $f_2 = v - c_2$ and a reasonable f_1 (which can be greater than $v - c_2$ and we will discuss it later) to ensure that it earns $v - c_2$ from recommending S_1 to one consumer. Otherwise, when S_2's cost is too high, M cannot use S_2 to discipline S_1, because charging the transaction fee characterized in the baseline model yields a marketplace margin greater than $v - c_2$ for M. In this case, M charges $f_1 = \min\{\mu_1, v - c_1\}$ and the level of f_2 is irrelevant.

In subsequent analysis and discussion, we restrict our attention to the case where inequality (20) holds; otherwise the analysis is exactly the same as the baseline. Moreover,

[12] We assume that M recommends the low-cost supplier S_1 when it is indifferent between the two suppliers.

given the existence of multiple equilibria, we focus on the equilibrium that is most favorable to the platform. Then we can solve for the equilibrium transaction fee, wholesale price, procurement quantity, and direct price. Thus, we obtain the following proposition (proof is in the appendix).

Proposition 8. *Suppose* $G_i(s) = \frac{s}{\mu_i}$, $H(q) = \frac{q}{\bar{q}}$, *and* $c_1 \leq c_2 < \min\{c_1 + \mu_1, v - \widehat{\varphi}_1\}$. *In the equilibrium that maximizes* M*'s profits,* M *adopts the pure marketplace mode if the two suppliers have the same marginal cost, and* M *adopts the hybrid mode otherwise. The equilibrium wholesale price, transaction fees, and procurement quantities are as follows:*

$$\begin{aligned} w_1^* &= \frac{c_1 + c_2}{2}, \\ (f_1^*, f_2^*) &= \left(\frac{v - c_2}{1 - \sqrt{\frac{c_2 - c_1}{\mu_1}}}, v - c_2 \right), \\ (q_{m1}^*(w_1^*), q_{m2}^*(w_2^*)) &= \left(\frac{(c_2 - c_1)\bar{q}}{2c_2}, 0 \right), \end{aligned}$$

where $\widehat{\varphi}_1 \equiv \left(1 - \frac{\min\{\mu_1, v - c_1\}}{2\mu_1}\right) \min\{\mu_1, v - c_1\}$ *and* q_{mi}^* *is the quantity procured from* S_i.

Notably, although the two suppliers compete in their direct prices, or equivalently in their leakage proportion, the outcome of the competition depends solely on their marginal costs and is independent of their ability to induce leakage (i.e., switching cost parameters μ_i). As a result, M never recommends S_2, the supplier with a higher marginal cost, even if consumers are very likely to switch to S_1's direct channel (μ_1 is small) and very unlikely to switch to S_2's direct channel ($\mu_2 \to \infty$). The intuition is as follows: when S_2's marginal cost is sufficiently high, M's profit from recommending S_2 is too low for S_2 to be a competitive threat to S_1; consequently, the equilibrium coincides with that in the baseline model. By contrast, when S_2's marginal cost is relatively low though still higher than that of S_1, M strategically includes S_2 as a competitive threat to discipline S_1. In this case, M can guarantee itself a marketplace margin of $v - c_2$ as a marketplace by charging transaction fees $f_1 \in [v - c_2, f_1^*]$ and $f_2 = v - c_2$. Since S_1 retains a cost advantage, S_1 can always provide M with a marketplace margin of $v - c_2$ and secure M's recommendation. Thus, M disciplines S_1 purely based on S_2's marginal cost and therefore does not care about S_2's ability to induce leakage.

Notably, the equilibrium transaction fee charged to S_1 is increasing in the corresponding leakage propensity ($\frac{1}{\mu_1}$), which is exactly the opposite of the baseline result. This is because in the equilibrium that maximizes M's profit, M always makes a profit of $v - c_2$ by recommending S_1 regardless of the transaction fee charged to S_1. Consequently, M charges a

transaction fee such that S_1 makes zero profit by selling to consumers,[13] which minimizes S_1's equilibrium wholesale price and therefore maximizes M's profit. Thus, when consumers' leakage propensity increases and hence S_1 makes more profit in the direct channel, M charges a higher transaction fee to reduce S_1's profit on the marketplace, thereby keeping S_1's profit from selling to consumers at zero.

Furthermore, the equilibrium wholesale price and procurement quantity only depend on the suppliers' marginal costs. This is also different from the baseline model with a monopoly supplier, where the equilibrium wholesale price and procurement quantity depend not only on the supplier's marginal cost but also on consumers' valuation and switching costs. The intuition is as follows: in the equilibrium that maximizes the platform's profit, although M's marketplace margin is fixed at $v - c_2$, M can maximize its resale margin by minimizing S_1's profitability. To do so, M charges a high transaction fee to S_1 such that S_1 makes exactly zero profit from selling the product to consumers, which means S_1 can only make positive profit from selling to M. As a result, S_1 has the strongest incentive to sell to M and therefore charges the lowest wholesale price, which maximizes M's resale margin. Moreover, to deliver clear insights and intuition, we discuss the platform's strategies under perfect competition and imperfect competition respectively.

Under imperfect competition. Since S_1 is disciplined by the rival, S_1 must set its retail prices such that M's marketplace margin is $v - c_2$. Consequently, S_1's wholesale price and hence its profit are determined by its cost advantage compared with S_2. When S_1 has a cost advantage (i.e., $c_1 < c_2$), S_1 is able to offer a wholesale price lower than c_2 and make a positive profit from selling to M. Thus, M's resale margin $(v - w)$ is higher than that as a marketplace $(v - c_2)$. Importantly, M's procurement quantity is increasing in the difference in the suppliers' marginal costs (see Figure 5), that is, M's business model shifts toward the reseller mode when supplier competition is less intense. Moreover, since M cannot perfectly discipline S_1 in this case, M optimally adopts the hybrid mode by trading off the risk-free marketplace mode and the higher-margin reseller mode.

Under perfect competition. In the extreme case where the two suppliers have identical costs (i.e., $c_1 = c_2 = c$), S_1 has no cost advantage and therefore M can perfectly discipline S_1 such that S_1 can only make zero profit. Specifically, M can extract all surplus by charging transaction fees $f_1 = f_2 = v - c$. As a result, M procures nothing from suppliers and operates as a pure marketplace in equilibrium.

Although S_1's wholesale price and total profit are minimized in the equilibrium that maximizes the platform's profit, consumer surplus is maximized because the high transaction

[13] Specifically, S_1 makes negative profit on M's marketplace and positive profit in the direct channel, and these two parts cancel out.

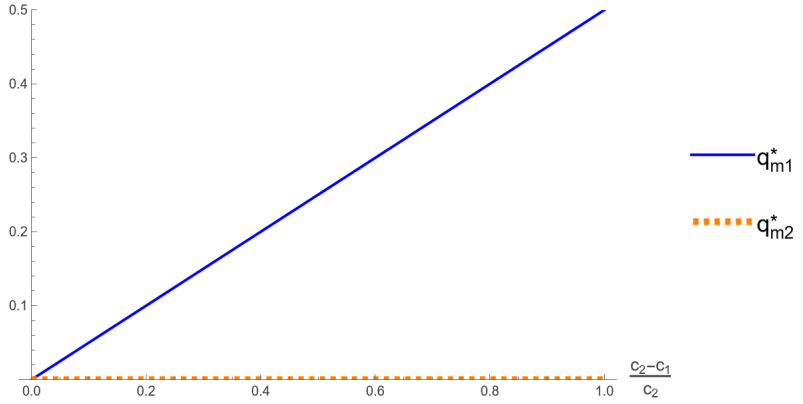


Figure 5: Procurement quantity (q^*_{mi}) versus cost difference ($\frac{c_2-c_1}{c_2}$) ($\bar{q} = 1$)

fee maximizes the leakage proportion. Thus, the interests of the platform and consumers are aligned in the presence of competing suppliers. Notably, the results of this section can be readily extended to a setting with N competing suppliers, where the platform only cares about the two suppliers with the lowest marginal costs and ignores the remaining suppliers.

5 Managerial Implications

Our model provides a number of implications for both platforms and suppliers, which we discuss in two separate sections below.

5.1 Implications for platforms

Hybrid mode is likely to be optimal, but not always: Under demand uncertainty and marketplace leakage, a hybrid business model frequently emerges as the profit-maximizing strategy. This dual-channel approach allows the platform to balance the operational flexibility inherent in the marketplace mode with the higher margin associated with the reseller mode. In addition, the hybrid model shields the platform from the disintermediation that is likely to arise in pure marketplaces. Nevertheless, certain contingencies may favor a pure regime. For instance, the platform should adopt a pure marketplace model by setting a commission that eliminates leakage if it can invest in marketplace transaction benefits at a sufficiently low cost. Furthermore, a pure marketplace mode is optimal when upstream competition is sufficiently fierce, enabling the platform to exert perfect discipline on suppliers. Conversely, the platform should converge toward a pure reseller mode when the supplier offers a comprehensive return policy, thereby eliminating the inventory risk associated with

demand uncertainty.

More leakage can lead to less reseller intensity: As the risk of disintermediation intensifies, the platform's optimal strategy may shift toward the marketplace mode while retaining a hybrid structure. Figure 1 depicts an inverted U-shaped relationship between the platform's reseller intensity and disintermediation risk. Table 2 shows platform examples that are consistent with the baseline resale mechanism and assumptions. Specifically, platforms facing very low disintermediation risk operate as pure marketplaces (e.g., DoorDash), while platforms facing severe leakage in non-procurable services (e.g., Upwork) have no reseller option (Panel B). Conversely, those facing intermediate risk levels derive a substantial share of their profits from reselling operations (e.g., Amazon, Coupang, and JD.com). Our model demonstrates that this structural transition is driven by the supplier's strategic incentive to charge a higher wholesale price as consumers' leakage propensity increases. Consequently, platform profitability is decreasing in disintermediation risk across both operational modes. Our model reveals a nuanced relationship: the platform might favor the marketplace mode (lower procurement) when disintermediation risk is high, but prioritize the reseller mode (higher procurement) when disintermediation risk is low. Symmetrically, while a lower wholesale price typically incentivizes procurement, it does not universally imply an increase in the optimal volume. The platform must exercise strategic prudence in its procurement decisions, particularly when operating under imperfect information regarding shifts in consumers' leakage propensity.

Utilize competition among suppliers: A platform can enhance its profitability by introducing a competing supplier. Even in the absence of a competitive advantage for the entrant, the platform can utilize the entry as a disciplinary mechanism against the incumbent. In this case, consumers' propensity to switch to the entrant's direct channel becomes irrelevant, as the platform lacks the incentive to redirect consumers toward an inefficient supplier. Consequently, the platform's strategic focus is confined to the entrant's marginal cost, which serves as the primary instrument for tempering the incumbent's wholesale pricing. Furthermore, the introduction of additional, non-advantaged suppliers yields no marginal benefit over a single-entrant framework. Conversely, when the entrant possesses a competitive advantage, the platform must account for both marginal costs and leakage risks. Specifically, the platform prefers suppliers with low marginal costs and a minimal ability to induce leakage.

5.2 Implications for suppliers

B2B and also B2C: For an upstream supplier, a dual-channel distribution strategy that integrates wholesale supply to the platform and direct-to-consumer marketplace sales dom-

Table 2: Platforms classified by fit to the baseline resale mechanism

Platform	Platform-owned Inventory	Seller Identity Visibility	Leakage Concerns	Procurable Products	Reseller Share
Panel A: Platforms matching the baseline resale mechanism					
Amazon[a]	✓	✓	✓[m]	✓	39%
Coupang[b]	✓	✓	✓[n]	✓	86%
JD.com[c]	✓	✓	✓[p]	✓	80%
Walmart[d]	✓	✓	✓[o]	✓	Not disclosed
Panel B: Platforms illustrating leakage or platform control, not resale					
Zillow[f]	×	× (via agent)	×	✓	n/a
Airbnb[g]	×	✓	✓[j]	×	n/a
Rover[h]	×	✓	✓[k]	×	n/a
Upwork[i]	×	✓	✓[l]	×	n/a

Notes. The baseline model assumes the platform (M) procures and owns inventory, resells a product whose provenance the consumer need not track, and controls recommendations so as to obscure the supplier's (S) direct channel. "Leakage concerns" record whether the platform maintains an official policy restricting off-platform transactions attached to a platform's marketplace side. "Reseller Share" is reported at the granularity each filing supports (see source notes). n/a: the platform does not resell. See Appendix B for full source citations.

inates a single-channel approach. The wholesale channel is usually more profitable, as the platform leverages its downstream market power to optimize the retail price and maximize surplus extraction. Concurrently, maintaining a presence on the platform's third-party marketplace allows the supplier to capture residual demand in instances where the platform's procurement volume is insufficient to satisfy total market demand. Moreover, maintaining a direct channel that induces leakage provides the supplier with greater market power and enables the supplier to set a higher wholesale price.

Strategic wholesale price: A monopoly supplier should set its wholesale price based on two factors: the uncertainty of consumer demand and consumers' leakage propensity. The supplier should lower its wholesale price when consumer demand is more uncertain and consumers are more hesitant to switch to the direct channel. However, when facing a rival supplier without a cost advantage, the incumbent supplier's optimal wholesale price should take into account the rival's marginal cost. Specifically, the optimal wholesale price is increasing in the competitor's marginal cost.

When to enter the market: In the presence of an incumbent supplier, a potential entrant's strategy depends on the relative marginal costs of the two firms. The entrant successfully displaces the incumbent if and only if it possesses a cost advantage, rendering its ability to induce leakage irrelevant to the entry condition. Upon entry, the efficient supplier (one

with a lower marginal cost) maximizes its profit by setting its wholesale price relative to the rival's marginal cost. This limit-pricing strategy is designed to disincentivize the platform from procuring from or providing marketplace access to the displaced rival supplier. Notably, a supplier's competitive advantage arises from a lower marginal cost while shutting down the direct channel does not help the supplier win the platform's recommendation.

6 Conclusion

This paper investigates how digital platforms strategically optimize their business models when confronted with the dual frictions of marketplace leakage (disintermediation) and consumer demand uncertainty. Through a game-theoretic framework featuring a monopoly platform and an integrated supplier, we establish that adopting a hybrid model that combines both reseller and marketplace functions is the platform's optimal equilibrium strategy. This hybrid approach enables platforms to effectively balance the high-margin efficiency of the reseller mode, which maximizes joint profits but incurs inventory risks, against the risk-free nature of the pure marketplace mode.

Furthermore, we examine the robustness of the hybrid model and the conditions under which pure business models prevail. The hybrid model remains optimal when wholesale and retail functions are performed by independent suppliers and when providing a return policy is costly for the supplier. However, when upfront commitment is possible, the platform prefers to commit to a pure reseller if consumers' leakage propensity and demand uncertainty are sufficiently high. We also identify conditions under which pure modes emerge without commitment. If providing a return policy is costless, the supplier offers a full return policy, inducing the platform to operate as a pure reseller. In addition, if the platform can invest in exclusive on-platform transaction benefits at a sufficiently low cost, it eliminates leakage and operates as a pure marketplace. Finally, with competing suppliers, the platform adopts the pure marketplace mode when suppliers have identical marginal costs, as competition allows it to extract the entire surplus through marketplace transactions. These findings provide nuanced economic insights into platforms' optimal choices of business models.

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A Appendix

A.1 Business model commitment by the supplier

We now examine S's incentive to commit to a pure business model. We introduce a stage 0 before the transaction fee and wholesale price are set, in which S can credibly commit to operating exclusively as a wholesaler or a retailer, or choose not to commit. The platform M cannot commit to a business model. Pure-wholesaler commitment precludes S from selling through either the marketplace or its direct channel, whereas pure-retailer commitment rules out wholesale supply to M. The baseline model is otherwise unchanged. Pure-wholesaler commitment generates the same equilibrium as M's pure-reseller commitment, while pure-retailer commitment generates the same equilibrium as M's pure-marketplace commitment. However, the two parties evaluate these outcomes differently because they receive different shares of the resulting profits.

We first consider pure-retailer commitment under general distributions $G(\cdot)$ and $H(\cdot)$. Such a commitment eliminates procurement but leaves the retail-pricing problem unchanged. The platform therefore chooses the same transaction fee f^* that maximizes its marketplace margin in the baseline. Writing $\varphi^* = \varphi(f^*)$ and $\psi^* = \psi(f^*)$ for brevity, the supplier's equilibrium profit under pure-retailer commitment is

$$\pi_{\mathrm{T}}^* = \psi^* \int_{\underline{q}}^{\bar{q}} q \, dH(q). \tag{21}$$

Without commitment, S can obtain this same payoff by setting $w > v - \varphi^*$, which induces zero procurement. Since S optimizes its wholesale price in the baseline, its equilibrium profit must satisfy

$$\pi_H^* \geq \pi_{\mathrm{T}}^*. \tag{22}$$

Thus, S never strictly benefits from committing to a pure retailer. Consequently, we focus on pure-wholesaler commitment in subsequent analysis.

To obtain analytical results, we assume that consumers' switching costs and demand are uniformly distributed, with $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\theta+\delta}{2\delta}$, where $\underline{q} = \theta - \delta$ and $\bar{q} = \theta + \delta$. Under pure-wholesaler commitment, S does not enter the marketplace and therefore earns only wholesale profit. Consequently, the equilibrium wholesale price and the platform's procurement quantity are identical to those when M commits to a pure reseller, which are

given by

$$
\begin{aligned}
w_R^* &= \min\left\{v, \frac{v(\theta+\delta)}{4\delta} + \frac{c}{2}\right\}, \\
q_{m,R}^{**} &= \max\left\{\theta-\delta, \frac{\theta+\delta}{2} - \frac{c\delta}{v}\right\}.
\end{aligned}
\tag{23}
$$

Thus, S's profit under pure-wholesaler commitment is

$$
\begin{aligned}
\pi_{\mathrm{W}}^* &= (w_R^* - c) q_{m,R}^{**} \\
&= \begin{cases} (v-c)(\theta-\delta), & \text{if} \quad \frac{\delta}{\theta} \le \frac{v}{3v-2c} \\ \frac{v}{2\delta}\left(\frac{\theta+\delta}{2} - \frac{c\delta}{v}\right)^2 & \text{if} \quad \frac{\delta}{\theta} > \frac{v}{3v-2c} \end{cases}.
\end{aligned}
\tag{24}
$$

This profit is strictly positive and independent of μ, because pure-wholesaler commitment eliminates the retail channels through which leakage occurs.

Without commitment, S earns both wholesale profit and retail profit from residual demand. Its equilibrium profit is

$$
\begin{aligned}
\pi_H^* &= (w_H^* - c) q_{m,H}^{**} + \psi^* \int_{q_{m,H}^{**}}^{\theta+\delta} (q - q_{m,H}^{**}) \frac{1}{2\delta}\, dq \\
&= \left(\frac{(v-\varphi^*)(\theta+\delta-q_{m,H}^{**})}{2\delta} - c \right) q_{m,H}^{**} + \frac{\psi^*}{4\delta}(\theta+\delta-q_{m,H}^{**})^2,
\end{aligned}
\tag{25}
$$

where

$$
\begin{aligned}
q_{m,H}^{**} &= \max\left\{\theta-\delta, \frac{(v-\varphi^*-\psi^*)(\theta+\delta) - 2c\delta}{2(v-\varphi^*) - \psi^*}\right\}, \\
\varphi^* &= \begin{cases} \mu/2 & \text{if} \quad \mu \le v-c \\ v-c-\dfrac{(v-c)^2}{2\mu} & \text{if} \quad \mu \ge v-c \end{cases}, \\
\psi^* &= \begin{cases} v-c-\frac{3\mu}{4} & \text{if} \quad \mu \le v-c \\ \frac{(v-c)^2}{4\mu} & \text{if} \quad \mu \ge v-c \end{cases}.
\end{aligned}
\tag{26}
$$

As μ increases, φ^* strictly increases and ψ^* strictly decreases. Thus, π_H^* is strictly increasing in $\frac{1}{\mu}$. Moreover, S's profit without commitment satisfies

$$
\begin{aligned}
\lim_{\mu\to 0} \pi_H^* &= \theta(v-c), \\
\lim_{\mu\to\infty} \pi_H^* &= 0,
\end{aligned}
\tag{27}
$$

while pure-wholesaler profit satisfies

$$
0 < \pi_{\mathrm{W}}^* < \theta(v-c). \tag{28}
$$

Consequently, continuity and monotonicity imply the existence of a unique threshold $\widehat{\mu}_S \in (0, \infty)$ satisfying $\pi_H^* = \pi_{\mathrm{W}}^*$. Moreover, $\pi_H^* < \pi_{\mathrm{W}}^*$ if and only if $\mu > \widehat{\mu}_S$.

Proposition 9. *Under marketplace leakage and demand uncertainty,*
(i) S never strictly benefits from pure-retailer commitment;
(ii) assuming $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\theta+\delta}{2\delta}$, there exists a unique $\widehat{\mu}_S > 0$ such that S strictly prefers pure-wholesaler commitment if and only if $\mu > \widehat{\mu}_S$.

Proposition 9 shows that the supplier's commitment incentive differs from the platform's: S prefers pure wholesale when leakage is sufficiently weak, whereas M prefers pure resale when leakage is sufficiently strong and demand uncertainty is sufficiently high. When leakage is weak, S earns a small retail margin, while M enjoys a large marketplace margin. In this case, S's pure-wholesaler commitment sacrifices relatively low retail profit and removes M's highly profitable marketplace, increasing M's willingness to pay for procurement. Thus, S benefits from pure-wholesaler commitment when consumers' leakage propensity is weak. However, when leakage is strong, S's retail sales become highly profitable, making pure-wholesaler commitment unbeneficial. Unlike M's commitment decision, S's decision does not require demand uncertainty to be sufficiently high. When demand uncertainty is sufficiently low, S charges $w_R^* = v$ and captures the entire surplus from serving the minimum-demand quantity. With greater demand uncertainty, S lowers its wholesale price but still earns strictly positive wholesale profit. For every level of demand uncertainty, this commitment profit is independent of μ, while S's profit without commitment converges to zero as $\mu \to \infty$. Thus, sufficiently weak leakage makes pure-wholesaler commitment strictly beneficial.

A.2 Informed consumers

In the baseline model, M acts as a gatekeeper: consumers cannot discover S unless they receive a recommendation for S's product. In this section, we relax this assumption by allowing a small proportion of informed consumers to discover S's direct channel independently. Specifically, while M's recommendation remains necessary for all consumers to find S on the marketplace, a fraction α of consumers can discover S's direct channel organically. For instance, some consumers may be aware of the supplier's website or offline store before visiting the platform. The baseline model is otherwise unchanged.

When informed consumers receive a recommendation for M's product, they observe M's resale price p_{resale} and S's direct price p_d. Therefore, they purchase in the direct channel if and only if

$$v - p_d - s \geq \max\{v - p_{resale}, 0\}.$$

Introducing informed consumers substantially complicates the analysis, even under uniform distributions. In the baseline, the trade-off S faces when setting its direct price is straightforward: a lower price encourages more consumers to switch to the direct channel but reduces the per-unit profitability of direct sales. This trade-off becomes more complex when some consumers are independently aware of the direct channel. On the one hand, the possibility of attracting informed consumers who are recommended M's product gives S an additional incentive to lower its direct price. On the other hand, a lower direct price increases leakage among these consumers, prompting M to recommend its own product to more consumers in an effort to clear its inventory. This reduces the residual demand routed to S and can offset the gains from attracting additional direct-channel purchases. Consequently, we do not obtain closed-form expressions for the equilibrium direct price, procurement quantity, wholesale price, or transaction fee.

We therefore explore this extension numerically, assuming uniform distributions and 10% informed consumers (i.e., $G(s) = \frac{s}{\mu}$, $H(q) = \frac{q-\theta+\delta}{2\delta}$, and $\alpha = 0.1$). In these simulations, we focus on a small fraction of informed consumers to limit the departure from the baseline and facilitate numerical convergence. The computed outcomes are numerical approximations to the equilibrium outcomes. Figure 6 plots the numerically computed procurement quantity against consumers' leakage propensity. Over the parameter values examined, the numerical results are consistent with the two main findings of the baseline model: M adopts a hybrid business model, and procurement exhibits an inverted-U relationship with leakage propensity. These results suggest that the baseline findings remain robust when a small fraction of consumers can discover S's direct channel independently.

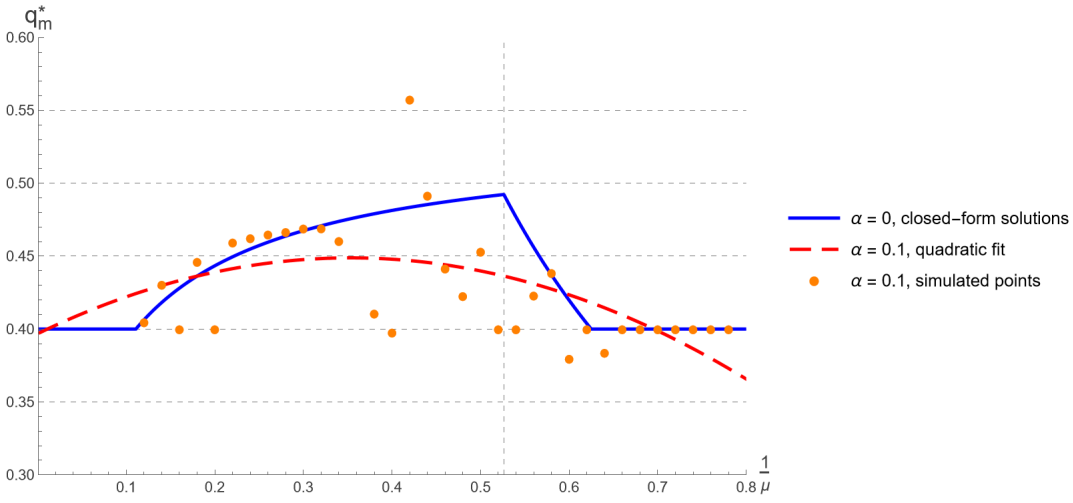


Figure 6: Procurement quantity (q_m^*) versus leakage propensity ($1/\mu$) with informed consumers (α) ($v = 2, \theta = 1, c = 0.1, \delta = 0.6$)

A.3 Proof of Lemma 1

If M sets the transaction fee $f > v - c$, S will make negative profit selling on M's marketplace. Since M can neither recommend nothing nor recommend its own product after its inventory is sold out, S responds to any fee $f > v - c$ by setting $p_m > v$, thereby avoiding loss-making marketplace sales while retaining access to consumers through M's recommendations. Consequently, no consumer will purchase on the marketplace. Furthermore, $f = 0$ is obviously a weakly dominated strategy. Thus, we must have $0 < f \leq v - c$.

To maximize profit, M must set the resale price equal to the consumer's valuation v and prioritize its own product by recommendations. To see this, consumers who receive the recommendation for M's product remain unaware of S. Consequently, they will purchase the product provided the price does not exceed v. Given that procurement costs are sunk and unsold inventory holds no salvage value, M earns a revenue of v by reselling one unit of the product. In contrast, if M recommends S's product, the profit per consumer is capped at the fee f, where $f \leq v - c \leq v$. Therefore, pricing at v and prioritizing its own product constitutes the optimal strategy for M.

Since there is no entry cost, entering the marketplace is a weakly dominant strategy for S. If M does not make a full procurement (i.e., $q_m < \bar{q}$), entering the marketplace raises S's expected profit because M will recommend S's product to consumers if the demand exceeds its inventory; if M makes a full procurement (i.e., $q_m = \bar{q}$), S is indifferent between entering the marketplace or not. Thus, S always chooses to list its product on the marketplace.

In the stage where all retail prices are determined, S's problem is to set p_m and p_d to maximize its profit. Given that $f \leq v - c$ and there is no price competition between M and S, S must set $v - \mu \leq p_d \leq p_m = v$. If $p_d = v$, no buyer will purchase from the direct channel, then S has no incentive to raise p_d. If $p_d = v - \mu$, all consumers will switch to the direct channel, then S has no incentive to reduce p_d. To see that p_m must be equal to v, suppose $p_m < v$, (i) if $p_d = v$, S can increase p_m by ε such that $p_m + \varepsilon < v$ and make higher profit; (ii) if $p_d < v$, S can increase p_m and p_d both by ε such that $p_m + \varepsilon < v$ and $p_d + \varepsilon < v$ and make higher profits without changing consumers' purchase decisions. Importantly, this logic also holds when M charges an ad-valorem transaction fee (commission), implying that S's optimal p_m is equal to v regardless of whether M charges a per-unit fee or a percentage fee. Thus, the form of the transaction fee does not change our results.

A.4 Proof of Lemma 2

Given $w > 0$, we distinguish three cases based on φ and $v - w$. First, suppose $\varphi < v - w$, where $\varphi \equiv (1 - l(p_d^*(f)))f$ as defined in the baseline. Equation (5) shows that

$q_m^* = H^{-1}\left(1 - \frac{w}{v-\varphi}\right)$. Therefore, for any fixed w, M's profit is

$$\Pi^*(\varphi) \equiv \Pi(q_m^*, \varphi) = \int_{\underline{q}}^{q_m^*} vq dH(q) + \int_{q_m^*}^{\bar{q}} \left(vq_m^* + \varphi(q - q_m^*)\right) dH(q) - wq_m^*. \tag{29}$$

By the envelope theorem,

$$\begin{aligned}\frac{d\Pi^*(\varphi)}{d\varphi} &= \left.\frac{\partial \Pi(q_m, \varphi)}{\partial \varphi}\right|_{q_m = q_m^*} \\ &= \int_{q_m^*}^{\bar{q}} (q - q_m^*)\, dH(q) > 0,\end{aligned}$$

where the strict inequality follows from $q_m^* < \bar{q}$ for any $w > 0$.

Second, suppose $\varphi > v - w$. M's optimal procurement is $q_m^* = 0$ and therefore M's profit is

$$\Pi^*(\varphi) = \int_{\underline{q}}^{\bar{q}} \varphi q\, dH(q),$$

implying that

$$\frac{d\Pi^*(\varphi)}{d\varphi} = \int_{\underline{q}}^{\bar{q}} q\, dH(q) > 0.$$

Finally, consider the boundary $\varphi = v - w$. As φ approaches $v - w$ from below, optimal procurement approaches $\underline{q}$ from above, whereas optimal procurement is zero for $\varphi > v - w$. As shown in the baseline, M is indifferent among all $q_m \in [0, \underline{q}]$ when $\varphi = v - w$, so we have

$$\Pi(\underline{q}, v - w) = \Pi(0, v - w). \tag{30}$$

Thus, the limits of optimized profit from both sides coincide with its value at the boundary, establishing continuity at $\varphi = v - w$. Together with strict monotonicity in each region, we can conclude that $\Pi^*(\varphi)$ is strictly increasing in φ.

Consequently, M's profit-maximizing transaction fee maximizes its marketplace margin from recommending S's product to consumers, that is,

$$f^* = \arg\max_f (1 - l(p_d^*(f)))f,$$

where

$$p_d^*(f) = \max\{p_d(f), v - \mu\} \tag{31}$$

and $p_d(f)$ is characterized by

$$p_d(f) = v - f + \frac{G(v - p_d(f))}{g(v - p_d(f))}.$$

Moreover, given that $G(\cdot)$ is log-concave, $p_d^*(f) < v$ for any $f > 0$. Thus, M's transaction fee induces partial leakage if its marketplace margin is strictly positive (i.e., $f > 0$ and $0 < l(p_d^*(f^*)) < 1$). In particular, if M charges $f = \mu$, then $p_d^*(\mu) > v - \mu$ leads to a strictly positive marketplace margin for M and non-full leakage (i.e., $l(p_d^*(f^*)) < 1$). Since M's optimal transaction fee leads to a weakly higher margin than charging $f = \mu$, it must generate a strictly positive marketplace margin for M and induce partial leakage.

A.5 Proof of Proposition 1

In this section, we first show that M adopts a hybrid business model in equilibrium and then provide conditions for unique equilibrium outcomes. Consistent with the main text, we suppress the argument f, writing φ and ψ to denote $\varphi(f)$ and $\psi(f)$ respectively. Given inequality (9), charging $w > v - \varphi$ is a weakly dominated strategy for S, and $w = 0$ is never the optimal wholesale price. Therefore, we restrict attention to wholesale prices $0 < w \leq v - \varphi$ in this proof.

Since $G(\cdot)$ is log-concave and $f > 0$, the optimal direct price and resulting leakage probability satisfy $p_d^*(f) < v$ and $l(p_d^*(f)) > 0$, which implies that

$$v - \varphi > \psi + c.$$

As shown in the baseline, M's equilibrium procurement satisfies $\underline{q} \leq q_m^* < \bar{q}$ when $\underline{q} > 0$. Thus, we focus on $\underline{q} = 0$ in the following analysis.

Suppose $\underline{q} = 0$. S's profit function is

$$q_m^*(w - c) + \int_{q_m^*}^{\bar{q}} (q - q_m^*)\psi dH(q).$$

For any $w \in (c + \psi, v - \varphi)$, integration by parts yields

$$\pi(w) - \pi(v - \varphi) = q_m^*(w - c - \psi) + \int_0^{q_m^*} \psi H(q)\, dq > 0, \tag{32}$$

where $q_m^* = H^{-1}\left(1 - \frac{w}{v-\varphi}\right)$. Therefore, S's optimal wholesale price satisfies $0 < w^* < v - \varphi$, implying that $0 < q_m^* < \bar{q}$ and M adopts the hybrid business model in equilibrium.

Next, we provide conditions under which S's optimal wholesale price and other equilibrium outcomes are unique. We first show that if $H(\cdot)$ is convex, then S's optimal wholesale price is unique for any $f > 0$.

If $H(\cdot)$ is convex, since we assume that $H(\cdot)$ is continuously differentiable over the support $[\underline{q}, \bar{q}]$, convexity implies that $h(q) > 0$ for $q \in (\underline{q}, \bar{q}]$ and hence

$$\pi'(w) = \left(\left(1 - \frac{\psi}{v-\varphi}\right)w - c\right)\frac{\partial H^{-1}\left(1-\frac{w}{v-\varphi}\right)}{\partial w} + H^{-1}\left(1 - \frac{w}{v-\varphi}\right) \tag{33}$$

is continuous over $[0, v-\varphi)$. Given that $\frac{\partial H^{-1}\left(1-\frac{w}{v-\varphi}\right)}{\partial w}$ is negative and decreasing in w, $\pi'(w) > 0$ for $w \in \left[0, \frac{(v-\varphi)c}{v-\varphi-\psi}\right]$, and $\pi'(w)$ is strictly decreasing for $w \in \left[\frac{(v-\varphi)c}{v-\varphi-\psi}, v-\varphi\right)$. In particular, taking derivative of $\pi(w)$ at $w = v-\varphi$ yields

$$\pi'(v-\varphi) = \underline{q} + (v-\varphi-\psi-c)\frac{\partial H^{-1}\left(1-\frac{w}{v-\varphi}\right)}{\partial w}\Big|_{w=v-\varphi},$$

which can be positive or negative depending on $\underline{q}$. If $\pi'(v-\varphi) < 0$, then there exists a unique $w^* \in \left(\frac{(v-\varphi)c}{v-\varphi-\psi}, v-\varphi\right)$ that maximizes S's profit. If $\pi'(v-\varphi) \geq 0$, then $\pi'(w)$ is strictly positive over the interval $[0, v-\varphi)$. Since charging $w > v-\varphi$ is never optimal for S, S's unique profit-maximizing wholesale price is $w^* = v-\varphi$. Thus, we can conclude that for any $f > 0$, S's optimal wholesale price is unique if $H(\cdot)$ is convex.

Furthermore, we show that M's optimal transaction fee is unique if

$$\frac{g(s)}{(1-G(s))T'(s)}$$

is increasing in s (given that $G(s)$ is log-concave), where $T(s) \equiv s + \frac{G(s)}{g(s)}$. This condition is satisfied by many commonly used distributions, including uniform, power, and exponential-form distributions.

By Lemma 2, M's optimal transaction fee induces partial leakage. Thus, we focus on $p_d^*(f) = p_d(f) > v-\mu$ for following analysis, where $p_d(f)$ is characterized by equation (2) and $p_d'(f) < 0$. Recall that M's marketplace margin is $\varphi(f) \equiv f\left(1 - G(v - p_d(f))\right)$ and differentiating $\varphi(f)$ yields

$$\varphi'(f) = 1 - G(v-p_d(f)) - f\frac{g(v-p_d(f))}{T'(v-p_d(f))}. \tag{34}$$

Then we define $R(s) \equiv \frac{g(s)}{(1-G(s))T'(s)}$, and substitute this into equation (34), which gives

$$\varphi'(f) = (1 - G(v - p_d(f)))\,(1 - fR(v - p_d(f)))\,. \tag{35}$$

By assumption, $R(s)$ is increasing in s. Moreover, given that $p_d'(f) < 0$,

$$\frac{d}{df}(v - p_d(f)) = -p_d'(f) > 0,$$

so $fR(v-p_d(f))$ is increasing in f and hence $1-fR(v-p_d(f))$ is decreasing in f. Furthermore, since

$$1 - G(v - p_d(f)) > 0$$

for $p_d(f) > v - \mu$, equation (35) implies that $\varphi'(f)$ can change sign at most once, and any sign change must be from positive to negative. Therefore, M's marketplace margin is single-peaked. Specifically, if there is an interior optimum, it is uniquely characterized by

$$f^* \frac{g(v - p_d(f^*))}{(1 - G(v - p_d(f^*)))T'(v - p_d(f^*))} = 1.$$

If the first-order condition is not reached before the upper bound $v - c$, then $\varphi'(f) > 0$ throughout the feasible interval, and the unique optimum is

$$f^* = v - c.$$

Thus, the equilibrium outcomes are unique if $G(\cdot)$ is log-concave, $H(\cdot)$ is convex, and

$$\frac{g(s)}{(1 - G(s))T'(s)}$$

is increasing in s.

A.6 Proof of Proposition 2

We assume that consumers' switching costs and aggregate demand are uniformly distributed such that $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q-\underline{q}}{\bar{q}-\underline{q}}$. Thus, M's equilibrium transaction fee is

$$f^*(\mu) = \min\{\mu, v - c\}\,,$$

and the equilibrium price in the direct channel is

$$p_d^*(\mu) = v - \frac{\min\{\mu, v-c\}}{2}.$$

Then, we can calculate M's marketplace margin from recommending S's product ($\varphi(f^*(\mu))$) and S's per-consumer profit ($\psi(f^*(\mu))$) in equilibrium, which are as follows:

$$\varphi(f^*(\mu)) = \begin{cases} \frac{\mu}{2} & \text{if} \quad \mu \le v-c \\ v-c-\frac{(v-c)^2}{2\mu} & \text{if} \quad \mu > v-c \end{cases},$$

$$\psi(f^*(\mu)) = \begin{cases} v-c-\frac{3\mu}{4} & \text{if} \quad \mu \le v-c \\ \frac{(v-c)^2}{4\mu} & \text{if} \quad \mu > v-c \end{cases}.$$

Intuitively, when consumers' switching costs increase (i.e., μ increases), M's marketplace margin increases but S's per-consumer profit decreases.

To facilitate the discussion of the comparative statics with respect to the demand factors, we denote $\underline{q} = \theta - \delta$ and $\bar{q} = \theta + \delta$, where θ is the mean of consumer demand and δ measures the uncertainty of consumer demand. Based on equations (10) and (12), we solve for the equilibrium wholesale price and procurement quantity as follows

$$w^* = \begin{cases} \min\left\{\frac{(2v-\mu)\left((\theta+\delta)(2v-\mu)+4\delta c\right)}{2\delta(4v+4c-\mu)}, \frac{2v-\mu}{2}\right\} & \text{if} \quad \mu \le v-c \\ \min\left\{\frac{(v-c)^2+2\mu c}{2\mu}\left(\frac{\theta+3\delta}{4\delta}+\frac{(v-c)^2(\theta-5\delta)}{4\delta(3(v-c)^2+8\mu c)}\right), \frac{(v-c)^2+2\mu c}{2\mu}\right\} & \text{if} \quad \mu > v-c \end{cases},$$

$$q_m^*(f^*, w^*) = \begin{cases} \max\left\{\frac{(\mu+4c)\theta+(\mu-4c)\delta}{4v+4c-\mu}, \theta-\delta\right\} & \text{if} \quad \mu \le v-c \\ \max\left\{\frac{\theta-\delta}{2}-\frac{(v-c)^2(\theta-5\delta)}{2(3(v-c)^2+8\mu c)}, \theta-\delta\right\} & \text{if} \quad \mu > v-c \end{cases}.$$

When $\frac{v-c}{\mu} \le 1$, w^* is always increasing in $\frac{1}{\mu}$ and decreasing in δ; q_m^* is always increasing in $\frac{1}{\mu}$, and increasing in δ if and only if $(v-c)^2 > 4\mu c$. When $\frac{v-c}{\mu} \ge 1$, w^* is increasing in $\frac{1}{\mu}$ and decreasing in δ; q_m^* is always decreasing in $\frac{1}{\mu}$, and increasing in δ if and only if $\mu \ge 4c$.

To understand this non-monotonic pattern of how q_m^* changes with $\frac{1}{\mu}$, recall that M's equilibrium procurement quantity is given by

$$q_m^*(\mu) = \bar{q} - \frac{w^*(\mu)}{v - \varphi(f^*(\mu))}(\bar{q} - \underline{q}), \tag{36}$$

where the equilibrium wholesale price $w^*(\mu)$ is decreasing in μ and M's equilibrium marketplace margin $\varphi(f^*(\mu))$ is increasing in μ. An increase in $\frac{1}{\mu}$ affects M's procurement quantity through two countervailing forces. On the one hand, stronger leakage propensity reduces M's marketplace margin (i.e., $\varphi(f^*(\mu))$ in the denominator), which encourages procurement

in favor of the reseller mode. On the other hand, greater leakage propensity allows S to increase the wholesale price ($w^*(\mu)$ in the numerator), which harms M's resale margin and drives M to operate as a marketplace. Thus, stronger leakage propensity can increase or decrease equilibrium procurement depending on whether S's wholesale price response dominates M's loss in marketplace margin. Table 3 shows the summary of platform's equilibrium transaction fee and comparative statics.

Table 3: Summary of the platform's equilibrium transaction fee and comparative statics

Condition	f^*	$\partial w^*/\partial \frac{1}{\mu}$	$\partial \varphi(f^*)/\partial \frac{1}{\mu}$	$\partial q_m^*/\partial \frac{1}{\mu}$
$\frac{v-c}{\mu} \leq 1$	$v-c$	$+$	$-$	$+$
$\frac{v-c}{\mu} \geq 1$	μ	$++$	$-$	$-$

Importantly, S's market power to set the wholesale price plays a critical role in driving this result: the responses of S's wholesale price to consumers' leakage propensity differ in the two cases ($\frac{v-c}{\mu} \leq 1$ or $\frac{v-c}{\mu} \geq 1$), which results from the different pressures S faces. As $\frac{1}{\mu}$ increases, consumers are more willing to switch to the direct channel, so the leakage probability increases (when $\frac{v-c}{\mu} \leq 1$) or the direct price rises (when $\frac{v-c}{\mu} \geq 1$). As a result, S's profitability in the direct channel increases. Moreover, there exists one mechanism enhancing S's profit on the marketplace only for $\frac{v-c}{\mu} \geq 1$: as $\frac{1}{\mu}$ increases (μ decreases), the transaction fee also reduces as $f^* = \mu$, directly increasing S's profitability of marketplace sales. In contrast, when $\frac{v-c}{\mu} \leq 1$, M's transaction fee is capped at $v-c$ and hence the change of $\frac{1}{\mu}$ has no impact on S's profitability on the marketplace. Thus, when $\frac{v-c}{\mu} \geq 1$, S enjoys a "double benefit" by selling to consumers in the direct channel and on the marketplace as the leakage propensity $\frac{1}{\mu}$ increases. Consequently, S's incentive to raise the wholesale price in response to a higher $\frac{1}{\mu}$ is stronger when $\frac{v-c}{\mu} \geq 1$.

Meanwhile, the change of M's marketplace margin $\varphi(f^*(\mu))$ is driven by two mutually exclusive forces that never operate simultaneously. In response to a higher $\frac{1}{\mu}$: when $\frac{v-c}{\mu} \leq 1$, M's transaction fee is capped at $v-c$, leaving the rising consumer switching probability as the active force that reduces the marketplace margin; when $\frac{v-c}{\mu} \geq 1$, the marketplace margin is shaped entirely by M strategically lowering the transaction fee because the consumer switching probability remains constant.

Taken together, these mechanisms reveal that when $\frac{v-c}{\mu} \geq 1$, the wholesale price $w^*(\mu)$ increases sharply due to the "double benefit", whereas M's marketplace margin $\varphi(f^*(\mu))$ decreases moderately. Consequently, M's lower resale margin derived from the higher wholesale price outweighs the reduced marketplace margin, resulting in a net decrease in procurement quantity. Thus, the platform's business model can shift toward the marketplace mode in response to greater leakage propensity.

A.7 Proof of Proposition 3

As solved in the main text, the equilibrium wholesale price and procurement quantity under pure-reseller commitment are

$$w_R^* = \min\left\{v, \frac{v(\theta+\delta)}{4\delta} + \frac{c}{2}\right\},$$
$$q_{m,R}^*(w_R^*) = \max\left\{\theta - \delta, \frac{\theta+\delta}{2} - \frac{c\delta}{v}\right\}.$$

For brevity, we use $q_{m,R}^{**}$ to denote $q_{m,R}^*(w_R^*)$, and M's equilibrium profit as a pure reseller is

$$\begin{aligned}\Pi_R^* &= v\int_{\theta-\delta}^{\theta+\delta} \min\{q, q_{m,R}^{**}\}\frac{1}{2\delta}\,dq - w_R^* q_{m,R}^{**} \\ &= \frac{v}{4\delta}\left[(q_{m,R}^{**})^2 - (\theta-\delta)^2\right].\end{aligned} \tag{37}$$

Since pure-reseller commitment eliminates leakage to S's direct channel, the equilibrium outcomes do not depend on consumers' switching costs.

We next compare this profit with M's equilibrium profit without commitment, which is derived in the baseline analysis. Let $q_{m,H}^{**}$ denote the baseline procurement quantity. M's baseline profit is

$$\Pi_H^* = \theta\varphi^* + \frac{v-\varphi^*}{4\delta}\left[(q_{m,H}^{**})^2 - (\theta-\delta)^2\right], \tag{38}$$

where

$$\varphi^* = \begin{cases} \mu/2 & \text{if} \quad \mu \le v-c \\ v - c - \dfrac{(v-c)^2}{2\mu} & \text{if} \quad \mu \ge v-c \end{cases}.$$

Notably, if $\frac{\delta}{\theta} \le \frac{v}{3v-2c}$, then $q_{m,R}^{**} = \theta - \delta$ and therefore $\Pi_R^* = 0 < \Pi_H^*$. Thus, we focus on $\frac{\delta}{\theta} > \frac{v}{3v-2c}$ in subsequent analysis.

We first show that when $\mu \ge v - c$, M makes a strictly lower profit under pure-reseller commitment. For $\mu \ge v - c$, the equilibrium marketplace margin satisfies

$$\varphi^* = v - c - \frac{(v-c)^2}{2\mu} \ge \frac{v-c}{2}.$$

Since $q_{m,H}^{**} \ge \theta - \delta$, M's equilibrium profit under hybrid mode satisfies

$$\begin{aligned}\Pi_H^* &= \theta\varphi^* + \frac{v-\varphi^*}{4\delta}\left[(q_{m,H}^{**})^2 - (\theta-\delta)^2\right] \\ &\ge \theta\varphi^* \ge \frac{\theta(v-c)}{2}.\end{aligned} \tag{39}$$

Under pure-reseller commitment, $\frac{v}{3v-2c} < \frac{\delta}{\theta} \leq 1$ implies

$$w_R^* = \frac{v(\theta+\delta)}{4\delta} + \frac{c}{2} \geq \frac{v+c}{2},$$
$$q_{m,R}^{**} = \frac{\theta+\delta}{2} - \frac{c\delta}{v} \in (\theta-\delta, \theta].$$

Given that realized resale quantity cannot exceed procurement, we have

$$\begin{aligned} \Pi_R^* &= v\int_{\theta-\delta}^{\theta+\delta} \min\{q, q_{m,R}^{**}\}\frac{1}{2\delta}\,dq - w_R^* q_{m,R}^{**} \\ &< (v - w_R^*)q_{m,R}^{**} \\ &\leq \frac{v-c}{2} q_{m,R}^{**} \\ &\leq \frac{\theta(v-c)}{2} \leq \Pi_H^*. \end{aligned} \tag{40}$$

The first inequality is strict because $q_{m,R}^{**} > \theta - \delta$, so some inventory remains unsold with positive probability. Thus, $\Pi_H^* > \Pi_R^*$ whenever $\mu \geq v - c$, implying that M strictly prefers no commitment to pure-reseller commitment.

Suppose $\mu < v - c$ and $\frac{\delta}{\theta} > \frac{v}{3v-2c}$. The baseline procurement is

$$q_{m,H}^{**} = \max\left\{\theta - \delta, \frac{4c(\theta-\delta) + \mu(\theta+\delta)}{4(v+c) - \mu}\right\}, \tag{41}$$

and the corresponding profit is

$$\Pi_H^* = \frac{\theta\mu}{2} + \frac{2v-\mu}{8\delta}\left(\left(\max\left\{\theta - \delta, \frac{4c(\theta-\delta) + \mu(\theta+\delta)}{4(v+c) - \mu}\right\}\right)^2 - (\theta-\delta)^2\right). \tag{42}$$

This profit is continuous and strictly increasing in μ on $(0, v-c]$, and it converges to zero as μ approaches zero. By contrast, Π_R^* is strictly positive and independent of μ. Moreover, we have shown that $\Pi_H^* > \Pi_R^*$ if $\mu = v - c$. Consequently, there exists a unique $\widehat{\mu} \in (0, v-c)$ such that $\Pi_R^* > \Pi_H^*$ if and only if $\mu < \widehat{\mu}$.

If baseline procurement equals minimum demand at the cutoff, then $\Pi_H^* = \frac{\theta\mu}{2}$, yielding $\widehat{\mu} = \frac{2\Pi_R^*}{\theta}$. Otherwise, equating the two profits yields $A\widehat{\mu}^2 - B\widehat{\mu} + C = 0$, whose smaller root is the unique cutoff in $(0, v-c)$. Thus, the explicit expression for $\widehat{\mu}$ is

$$\widehat{\mu} = \begin{cases} \frac{2\Pi_R^*}{\theta} & \text{if} \quad \Pi_R^* \leq v(\theta-\delta) \\ \frac{B - \sqrt{B^2 - 4AC}}{2A} & \text{if} \quad \Pi_R^* > v(\theta-\delta) \end{cases}, \tag{43}$$

where

$$A = \delta\Pi_R^* + v(\theta^2 + \theta\delta + \delta^2) + 2c\theta(\theta + \delta),$$
$$B = 8\delta(v + c)\left[\theta(v + c) + \Pi_R^*\right] + 4v(\theta - \delta)\left[(v + c)(\theta - \delta) + c\theta\right],$$
$$C = 16\delta(v + c)^2\Pi_R^* + 4v^2(v + 2c)(\theta - \delta)^2,$$

and

$$\Pi_R^* = \frac{v}{4\delta}\left[\left(\frac{\theta + \delta}{2} - \frac{c\delta}{v}\right)^2 - (\theta - \delta)^2\right].$$

A.8 Proof of Proposition 6

We first demonstrate that, in equilibrium, M continues to prioritize its own product when making recommendations, even when S offers a product return policy. Suppose $q_m \leq q_r$, that is, M's procurement quantity does not exceed the maximum allowable return quantity. M faces no inventory risk, as all procured units can be returned to the supplier. Consequently, M's recommendation strategy depends entirely on the relative profitability of its reseller margin $v - w$ and its marketplace margin φ. Specifically, M prioritizes S's product if and only if $v - w < \varphi$. Under this condition, M operates as a pure marketplace, and S derives its profit exclusively from sales to consumers. Following inequality (9) and Proposition 1, S's profit, $\pi(w, q_r)$, must satisfy

$$\pi(w, q_r) \leq \int_{\underline{q}}^{\bar{q}} q\psi dH(q) < q_m^*(w^* - c) + \int_{q_m^*}^{\bar{q}} (q - q_m^*)\psi dH(q). \tag{44}$$

The weak inequality holds because M can procure $q_m \leq q_r$ and return all of them, leaving S with a net return cost of $(1 - \beta)cq_m$. The strict inequality follows from the condition $w^* < v - \varphi$, as established in the proof of Proposition 1. This highlights one of the central insights of our baseline model: S's profit is strictly suboptimal if it relies solely on consumer sales. In other words, if $v - w < \varphi$, S will have incentives to deviate to the prices characterized in the baseline and simply set $q_r = 0$.

Then suppose $q_m > q_r$. M will first try to clear $q_m - q_r$ units of its inventory because the procurement cost for those products is sunk. That is, M will recommend its own product to consumers until the residual inventory is reduced to q_r. Once M successfully clears these $q_m - q_r$ units, its inventory risk is eliminated, and it again evaluates the trade-off between its reseller and marketplace margins. From this point onward, the logic reverts to the $q_m \leq q_r$ case that we analyzed above.

Thus, the following analysis is based on the fact that M always prioritizes its own product. We distinguish two cases based on S's marginal cost ($c > 0$ and $c = 0$), and first consider the

case where $c > 0$. Given the maximal return quantity q_r, M chooses a procurement quantity to maximize the following profit function

$$\Pi(q_m) = \begin{cases} \int_0^{q_m} q\,(v-w)\,dH(q) + \int_{q_m}^{\bar{q}} q_m\,(v-w) + (q-q_m)\varphi dH(q) & \text{if} \quad q_m \le q_r \\ \int_0^{q_m-q_r} qv + q_r w - q_m w dH(q) + \int_{q_m-q_r}^{q_m} q(v-w)dH(q) & \\ + \int_{q_m}^{\bar{q}} q_m v + (q-q_m)\varphi - q_m w dH(q) & \text{if} \quad q_r \le q_m \le \bar{q} \end{cases}.$$

Based on uniformly distributed consumer demand (i.e., $H(q) = \frac{q}{\bar{q}}$), solving M's profit maximization problem yields the following optimal procurement quantity

$$q_m^*(f, w, q_r) = \begin{cases} 0 & \text{if} \quad w > v - \varphi \\ \frac{w}{v-\varphi} q_r + \left(1 - \frac{w}{v-\varphi}\right)\bar{q} & \text{if} \quad w \le v - \varphi \end{cases}, \tag{45}$$

where φ is consistent with that in the baseline analysis. Given the expression of M's optimal procurement quantity, S sets $w \le v - \varphi$ and $q_r \le \bar{q}$ to maximize its expected total profit

$$\begin{aligned} \pi(w, q_r) = &\int_0^{q_m^*-q_r} (q_m^* - q_r)w + \beta q_r c dH(q) + \int_{q_m^*-q_r}^{q_m^*} qw + \beta(q_m^* - q)c dH(q) \\ &+ \int_{q_m^*}^{\bar{q}} q_m^* w + (q - q_m^*)\psi dH(q) - q_m^* c, \end{aligned}$$

where ψ is consistent with that in the baseline analysis.

Then we analyze two scenarios based on the value of β. First suppose $0 \le \beta < 1$. Solving the FOC with respect to w yields

$$w(q_r) = \frac{(m(q_r)^2 + 1)(v - \varphi) + 2c[(1-\beta)m(q_r) + \beta]}{2\left(2 - \frac{\psi}{v-\varphi}\right)},$$

where $m(q_r) = \frac{\bar{q}}{\bar{q}-q_r}$. Since S's optimal wholesale price does not exceed $v - \varphi$ and $w(q_r)$ is increasing in q_r, we define a critical value of the return quantity $\widehat{q}_r$ by the following equation

$$w(\widehat{q}_r) = v - \varphi.$$

In other words, S charges the wholesale price $w = v - \varphi$ if $q_r \ge \widehat{q}_r$. Then, we take the total derivative with respect to q_r by substituting in $w(q_r)$ and obtain

$$\frac{d\pi(w(q_r), q_r)}{dq_r} = \begin{cases} \frac{(\bar{q}-q_r)\beta c}{\bar{q}}\left(1 - \frac{w(q_r)}{v-\varphi}\right) + \frac{(2\bar{q}-q_r)q_r w(q_r)}{2\bar{q}(\bar{q}-q_r)} & \text{if} \quad q_r \le \widehat{q}_r \\ \left(1 - \frac{q_r}{\bar{q}}\right)(v - \varphi - \psi) - \left(1 - \frac{\beta q_r}{\bar{q}}\right)c & \text{if} \quad q_r \ge \widehat{q}_r \end{cases}. \tag{46}$$

Recall that in the baseline analysis, we have

$$v - \varphi > \psi + c.$$

Since the φ and ψ in this section are the same as those in the baseline, this inequality still holds. Consequently, $\frac{d\pi(w(q_r),q_r)}{dq_r}$ is positive for $q_r \leq \widehat{q}_r$ and decreasing for $q_r \geq \widehat{q}_r$. Furthermore, it is equal to $-(1-\beta)c < 0$ when $q_r = \bar{q}$. Thus, there exists a unique and interior return quantity ($0 < q_r < \bar{q}$) that maximizes S's profit. As equation (45) shows, M's optimal procurement quantity is a convex combination of q_r and $\bar{q}$. Therefore, M's equilibrium procurement quantity is less than $\bar{q}$, implying that M adopts the hybrid mode.

Next, suppose $\beta = 1$. Taking the partial derivative w.r.t q_r yields

$$\frac{\partial \pi(w, q_r)}{\partial q_r} = \left(\frac{\bar{q} - q_r}{\bar{q}}\right)\left((w-c)\left(\frac{2w}{v-\varphi} - 1\right) - \psi\left(\frac{w}{v-\varphi}\right)^2\right), \tag{47}$$

which is always positive or negative for a given w. Thus, S's optimal return quantity must be a corner solution, that is, $q_r^* = 0$ or $\bar{q}$.[14] We show that S has a unique optimal return quantity $q_r^* = \bar{q}$ by contradiction. Suppose the return quantity is $q_r = 0$. The corresponding optimal wholesale price is

$$w^* = \frac{v - \varphi + c}{2 - \frac{\psi}{v-\varphi}} < v - \varphi,$$

where the inequality holds because $v - \varphi > \psi + c$. Moreover, given that $c > 0$, we have

$$\left.\frac{\partial \pi(w, q_r)}{\partial q_r}\right|_{w=w^*, q_r=0} = \frac{c(v - \varphi - \psi - c)}{2(v-\varphi) - \psi} > 0,$$

meaning that S can make more profit by increasing q_r, which contradicts $q_r^* = 0$. Moreover, this result also rules out the possibility that S is indifferent between any $q_r \in [0, \bar{q}]$ in equilibrium. Thus, S's unique equilibrium return quantity is $q_r^* = \bar{q}$, implying that the risk of excessive inventory is fully covered by the return policy. Consequently, M will procure $\bar{q}$ and operate as a pure reseller in equilibrium.

We next examine the case where $c = 0$. Since providing a return policy remains costless for S under this scenario, the underlying logic aligns with the previously discussed case where $c > 0$ and $\beta = 1$. Thus, S always provides a full return policy ($q_r = \bar{q}$) and charges $w = v - \varphi$ to maximize its profit. In this case, M is indifferent between the reseller and marketplace modes because the marketplace margin and resale margin are equal and the inventory risk is fully covered by the return policy. Consequently, M's profit is driven to

[14] We assume the tie-breaking rule is that S sets $q_r = 0$ if S is indifferent between all return quantities.

its minimum, which is exactly the profit level that can be ensured by operating as a pure marketplace. Furthermore, consumer surplus is also minimized, as the pure reseller mode yields zero surplus for consumers. Thus, S maximizes its own profit by setting $q_r = \bar{q}$ and $w = v - \varphi$.

A.9 Proof of Lemma 4

We first show that M's optimal transaction fee satisfies $b \leq f \leq v + b - c$. If M sets $f \leq b$, S will have no incentive to induce any leakage since the profit from selling through M's marketplace ($v - c + b - f$) is higher than that from selling through its own direct channel (at most $v - c$). Thus, M can make more profit by raising the transaction fee to b if it is strictly lower than b. On the other hand, if M sets $f > v + b - c$, S will make negative profit from selling on M, and therefore S will set $p_m > v + b$ such that no buyer purchases on M. Thus, we must have $b \leq f \leq v + b - c$.

Given that consumers' valuation is $v + b$ when purchasing on M, M must set the resale price equal to $v + b$ and prioritize the recommendation of its own product. The logic follows that of Lemma 1: consumers who receive the recommendation for M's product remain unaware of S and therefore, they will purchase the product provided the price does not exceed $v + b$. Given that procurement costs are sunk and unsold inventory holds no salvage value, M earns a profit of $v + b$ per unit. In contrast, if M recommends S's product, the profit per consumer is capped at the fee f, where $f \leq v + b - c \leq v + b$. Therefore, pricing at $v + b$ and prioritizing its own product constitutes the optimal strategy for M.

Given $b \leq f \leq v + b - c$, we can show that S's optimal prices satisfy $v - \mu \leq p_d \leq v$ and $p_m = v + b$ following the same logic as in the proof of Lemma 1.

A.10 Proof of Proposition 7

Similar to the baseline analysis, we use backward induction to solve for the subgame-perfect Nash equilibrium. Since Lemma 4 shows that $p_m = p_{resale} = v + b$, S sets the direct price to maximize its total expected profit from selling to the platform and consumers

$$\pi(p_d) = q_m(w - c) + \int_{q_m}^{\bar{q}} (q - q_m)((p_d - c)l(p_d) + (v + b - c - f)(1 - l(p_d)))dH(q),$$

where

$$l(p_d) = G(v - p_d).$$

Given Lemma 4, we focus on the case where $f \geq b$. Suppose $G(s) = \frac{s}{\mu}$ and $H(q) = \frac{q}{\bar{q}}$. S's optimal direct price is a function of the transaction fee and benefits, specifically,

$$p_d^*(f,b) = \max\{v - \frac{f-b}{2}, v - \mu\}.$$

Intuitively, S's optimal direct price is increasing in the consumer benefits since S can charge a higher price on M's marketplace and earn more profit from marketplace sales. Notice that if M charges a transaction fee greater than $2\mu + b$, S will set a direct price that induces full leakage and hence M will make zero profit as a marketplace. Thus, charging any $f > 2\mu + b$ is a weakly dominated strategy for M and thus we restrict our attention to the case where $f \leq 2\mu + b$ for subsequent analysis of this section.

With the investment cost $K(b) = \frac{kb^2}{2}$, M chooses the procurement quantity to maximize its total expected profit from operating as a marketplace and a reseller

$$\Pi(q_m) = \int_0^{q_m} q(v+b)dH(q) + \int_{q_m}^{\bar{q}} q_m(v+b) + (q-q_m)\varphi(f,b)dH(q) - q_m w - \frac{kb^2}{2}, \quad (48)$$

where $\varphi(f,b)$ is M's marketplace margin from recommending S's product to consumers and is defined by

$$\varphi(f,b) \equiv (1 - l(p_d^*(f,b)))f = f - \frac{f(f-b)}{2\mu}.$$

Therefore, we can solve for M's optimal procurement quantity

$$q_m^*(f,b,w) = \begin{cases} 0 & \text{if} \quad w > v + b - \varphi(f,b) \\ \left(1 - \frac{w}{v+b-\varphi(f,b)}\right)\bar{q} & \text{if} \quad w \leq v + b - \varphi(f,b) \end{cases} \quad (49)$$

Since $q_m^* = 0$ if $w \geq v + b - \varphi(f,b)$, charging $w > v + b - \varphi(f,b)$ is a weakly dominated strategy for S. Thus, we restrict our attention to the case where $w \leq v + b - \varphi(f,b)$.

Similar to the baseline, M's optimal transaction fee maximizes its marketplace margin $\varphi(f,b)$, that is,

$$f^*(b) = \arg\max_f f - \frac{f(f-b)}{2\mu}.$$

Given that M's optimal transaction fee is bounded below by b, it satisfies

$$f^*(b) = \begin{cases} b & \text{if} \quad b \geq 2\mu \\ \mu + \frac{b}{2} & \text{if} \quad b \leq 2\mu \end{cases}. \quad (50)$$

Combining equations (48), (49) and (50), we can write M's profit as a function of b

$$\Pi(b) = \begin{cases} \frac{\bar{q}w^2}{2v} + \frac{\bar{q}(v+b)}{2} - \frac{kb^2}{2} - \bar{q}w & \text{if} \quad b \geq 2\mu \\ \frac{\bar{q}w^2}{2v-\mu+b-\frac{b^2}{4\mu}} + \frac{\bar{q}(v+b)}{2} - \frac{kb^2}{2} - \bar{q}w & \text{if} \quad b \leq 2\mu \end{cases}.$$

Taking the first derivative of $\Pi(b)$, we obtain

$$\Pi'(b) = \begin{cases} \frac{\bar{q}}{2} - kb & \text{if} \quad b \geq 2\mu \\ \frac{\bar{q}}{2} - kb - \frac{\bar{q}w^2\left(1-\frac{b}{2\mu}\right)}{\left(2v-\mu+b-\frac{b^2}{4\mu}\right)^2} & \text{if} \quad b \leq 2\mu \end{cases}.$$

Moreover, if $b \leq 2\mu$, the second derivative is

$$\Pi''(b) = -k + \frac{\bar{q}w^2}{\left(2v-\mu+b-\frac{b^2}{4\mu}\right)^3}\left(\frac{2v-\mu+b-\frac{b^2}{4\mu}}{2\mu} + 2\left(1-\frac{b}{2\mu}\right)^2\right). \tag{51}$$

Notice that for $b \in [0, 2\mu]$, $2v - \mu + b - \frac{b^2}{4\mu}$ is increasing and $1 - \frac{b}{2\mu}$ is decreasing in b. Thus, $\Pi''(b)$ is strictly decreasing, implying that $\Pi'(b)$ is strictly concave for $b \in [0, 2\mu]$.

Then we solve for S's optimal wholesale price based on its profit function

$$\pi(w) = q_m^*(f, b, w)(w - c) + \int_{q_m^*(f,b,w)}^{\bar{q}} (q - q_m^*(f, b, w))\psi(f, b)dH(q)$$

and obtain

$$w^*(f, b) = \frac{v + b - \varphi(f, b) + c}{2 - \frac{\psi(f,b)}{v+b-\varphi(f,b)}}, \tag{52}$$

where $\psi(f, b)$ is S's expected profit from selling its own product to one consumer and is defined by

$$\begin{aligned} \psi(f, b) &\equiv (v + b - c - f)(1 - l(p_d^*(f, b))) + (p_d^*(f, b) - c)l(p_d^*(f, b)) \\ &= v - c - (f - b) + \frac{(f - b)^2}{4\mu}. \end{aligned}$$

We are now ready to prove Proposition 7. We first consider the condition that $k \leq \frac{\bar{q}}{4\mu}$, under which we can demonstrate that M's investment in transaction benefits satisfies $b^* \geq 2\mu$ and M is a pure marketplace in equilibrium. Suppose instead M chooses $b^* < 2\mu$. Therefore, M's transaction fee is $f^* = \mu + \frac{b^*}{2}$ and S's wholesale price satisfies

$$w^* \leq v + b^* - \varphi(f^*, b^*) = v - \frac{\mu}{2} + \frac{b^*}{2} - \frac{b^{*2}}{8\mu} < v. \tag{53}$$

Moreover, $k \leq \frac{\bar{q}}{4\mu}$ implies

$$\Pi'(2\mu) = \frac{\bar{q}}{2} - 2\mu k \geq 0.$$

Since $\Pi'(2\mu) \geq 0$ and $\Pi'(b)$ is strictly concave over $[0, 2\mu]$, $\Pi(b)$ is strictly quasi-convex over $[0, 2\mu]$. Therefore, to show $\Pi(2\mu) > \Pi(b)$ for any $b \in [0, 2\mu)$, it is sufficient to show that

$$\Pi(2\mu) > \Pi(0) \Leftrightarrow \bar{q}\mu - 2k\mu^2 + \bar{q}\left(\frac{w^2}{2v} + \frac{v}{2} - w\right) > \bar{q}\left(\frac{w^2}{2v-\mu} + \frac{v}{2} - w\right). \tag{54}$$

Given that $w < v$ and $\mu \leq v - c$, we have $v(2v - \mu) > w^2$. Dividing by $v(2v - \mu)$ and multiplying by $\frac{\bar{q}}{2}$ gives

$$\frac{\bar{q}}{2} > \frac{\bar{q}w^2}{2v(2v-\mu)}.$$

Applying the given parameter condition $k \leq \frac{\bar{q}}{4\mu}$ ensures $\bar{q} - 2k\mu \geq \frac{\bar{q}}{2}$. By transitivity, this establishes

$$\bar{q} - 2k\mu > \frac{\bar{q}w^2}{2v(2v-\mu)}.$$

Multiplying the entire inequality by μ and applying the algebraic identity $\frac{\mu}{2v(2v-\mu)} = \frac{1}{2v-\mu} - \frac{1}{2v}$, we obtain

$$\bar{q}\mu - 2k\mu^2 + \frac{\bar{q}w^2}{2v} > \frac{\bar{q}w^2}{2v-\mu}.$$

Adding the common term $\bar{q}\left(\frac{v}{2} - w\right)$ to both sides directly yields the desired inequality

$$\bar{q}\mu - 2k\mu^2 + \bar{q}\left(\frac{w^2}{2v} + \frac{v}{2} - w\right) > \bar{q}\left(\frac{w^2}{2v-\mu} + \frac{v}{2} - w\right).$$

Thus, we have constructed a contradiction for $b^* < 2\mu$ in equilibrium.

As a consequence, M's optimal investment in transaction benefits must satisfy $b^* \geq 2\mu$. Based on equations (52) and (50), we have $f^* = b^*$ and the equilibrium wholesale price is $w^* = v$. Thus, we can show that $\Pi(0) \leq \Pi(2\mu)$ and hence $\Pi(2\mu) \geq \Pi(b)$ for any $b \in [0, 2\mu]$. Moreover, since $\Pi'(b)$ is decreasing for $b \geq 2\mu$, the unique profit-maximizing investment in transaction benefits is given by

$$b^* = \frac{\bar{q}}{2k} > 2\mu.$$

Importantly, since $w^* = v + b - \varphi(f^*, b^*) = v$, which means M's profitability from reselling is equal to that from charging the transaction fee, M procures nothing and chooses to be a pure marketplace considering the risk of consumer demand.

Then we consider another condition that $k > \frac{\bar{q}}{4\mu}$. Suppose the equilibrium exists.[15] We

[15]To ensure the existence of equilibrium, a sufficient condition is $\mu \leq (2 - \sqrt{2})v$, which guarantees that

can demonstrate that M's investment in transaction benefits satisfies $0 < b^* < 2\mu$ and M adopts the hybrid mode in equilibrium. Since $k > \frac{\bar{q}}{4\mu}$, it follows that

$$\Pi'(2\mu) = \frac{\bar{q}}{2} - 2\mu k < 0,$$

implying that $\Pi(b)$ is decreasing for $b \geq 2\mu$ and M's profit-maximizing investment in transaction benefits satisfies $b^* < 2\mu$ given that $\Pi'(b)$ is continuous. Since $b^* < 2\mu$ in equilibrium, M's transaction fee is $f^* = \mu + \frac{b^*}{2}$ and S's wholesale price satisfies

$$w^* = \frac{v + b^* - \varphi(f^*, b^*) + c}{2 - \frac{\psi(f^*, b^*)}{v + b - \varphi(f^*, b^*)}} < v + b^* - \varphi(f^*, b^*). \tag{55}$$

As a result, $q_m^*(f^*, b^*, w^*) > 0$ and M adopts the hybrid mode. Moreover, if $b = 0$, we have $w^* \leq v + b^* - \varphi = v - \frac{\mu}{2}$ and therefore $\Pi'(0) > 0$. Thus, we can conclude that M's optimal investment in transaction benefits satisfies $0 < b^* < 2\mu$ and M adopts the hybrid mode in equilibrium.

A.11 Proof of Lemma 5

Following the same logic as in the proof of Lemma 1, we can show that the suppliers' retail prices on the marketplace and M's resale prices must be equal to v, i.e., $p_{m1} = p_{m2} = p_{resale} = v$.

To see that M recommends S_1 to consumers after its own inventory is sold out, M always first recommends its own product because the profit from resale exceeds the profit from charging transaction fees given that the procurement cost is sunk. M needs to recommend the suppliers' product to consumers if the realized consumer demand is higher than M's procurement quantity. Suppose M charges $f_1 = f_2 = v - c_2$. S_1 and S_2 will compete in their direct prices for M's recommendation because in this case M will recommend the supplier whose leakage proportion is lower after M's own inventory is sold out. As a result, the equilibrium direct prices will be $p_{d1} = p_{d2} = v$ and induce no leakage. Consequently, M can earn a marketplace margin of $v - c_2$ by recommending S_1. Since $v - c_2$ is already the highest marketplace margin that M can possibly make from charging a transaction fee to S_2, M has no incentive to recommend S_2. Throughout our analysis, we assume the tie-breaking rule is that M recommends the low-cost supplier S_1 when it is indifferent between the two suppliers, which leads to more efficient equilibrium outcomes. Otherwise, S_1 could deviate by offering M an arbitrarily small increase in the marketplace margin to secure the recommendation.

$\Pi(b)$ has a unique and interior maximizer. Thus, the equilibrium exists by Brouwer's fixed-point theorem.

Given that M always recommends S_1 and can ensure itself a marketplace margin of $v-c_2$ by charging $f_1 = f_2 = v - c_2$, M has no incentive to charge $f_1 < v - c_2$.

A.12 Proof of Proposition 8

First, we define two direct prices for S_1,

$$\widehat{p}_{d1} \equiv v - \frac{f_1}{2},$$
$$\widetilde{p}_{d1} \equiv v - \left(1 - \frac{v - c_2}{f_1}\right)\mu_1,$$

where $\widehat{p}_{d1}$ is the profit-maximizing direct price conditional on M recommending S_1 and $\widetilde{p}_{d1}$ is the direct price such that M makes a profit of $v - c_2$ by recommending S_1's product to one consumer. Since $v - c_2$ is the highest profit M can possibly make from recommending S_2's product to one consumer, S_1 can ensure M's recommendation by charging $\widetilde{p}_{d1}$. Since we assume condition (20) to differentiate the analysis from the baseline, we have

$$\widetilde{p}_{d1} \geq \widehat{p}_{d1}.$$

Then, if S_1 charges a direct price lower than $\widetilde{p}_{d1}$, M will recommend S_2 given Lemma 5. Moreover, since S_1 can ensure M's recommendation by charging $\widetilde{p}_{d1}$, it has no incentive to further increase the direct price. Thus, S_1's optimal direct price is $\widetilde{p}_{d1}$. Although M never recommends S_2, S_2's direct price helps M to discipline S_1 and it must satisfy $p_{d2} = v$ in equilibrium.

Similar to the baseline analysis, we can characterize M's optimal procurement quantity

$$q^*_{mi}(w_i) = \begin{cases} \left(1 - \frac{w_i}{c_2}\right)\bar{q} & \text{if } \ w_i \leq \min\{w_j, c_2\} \\ 0 & \text{otherwise} \end{cases}. \tag{56}$$

M chooses the supplier with a lower wholesale price and procures a positive quantity only when such a price generates a resale margin exceeding the potential marketplace margin (i.e., $v - w_i > v - c_2$). Thus, M never procures from S_2 because S_2's wholesale price never falls below its marginal cost.[16] Then, we can solve for S_1's optimal wholesale price

$$w_1^* = \frac{c_1 + c_2}{2 - \frac{\psi(f_1)}{c_2}}, \tag{57}$$

[16] We assume that M procures from the low-cost supplier S_1 when indifferent between the two suppliers.

where $\psi(f_1) = c_2 - c_1 - \left(1 - \frac{v-c_2}{f_1}\right)^2 \mu_1$.

M's equilibrium transaction fees satisfy $f_1^* \geq v - c_2$ and $f_2^* = v - c_2$, where $f_1^* \geq v - c_2$ is already shown in Lemma 5. Next, we show that M's equilibrium transaction fee to S_2 satisfies $f_2^* = v - c_2$. Given that $p_{d1}^* = \widetilde{p}_{d1}$, M's marketplace margin in equilibrium is equal to $v - c_2$. Thus, S_2's equilibrium prices satisfy $p_{m_2} = \max\{v, f_2 + c_2\}$ and $p_{d2} \geq p_{m_2}$. If charging $f_2 > v - c_2$, M's marketplace margin from recommending S_2 would be zero; if charging $f_2 < v - c_2$, M's marketplace margin from recommending S_2 would be strictly less than $v - c_2$. In either case, S_1 could set a direct price that yields the same marketplace margin for M and secure M's recommendation. Thus, M charges $f_2^* = v - c_2$ in equilibrium. The intuition is that S_1 can guarantee M's recommendation by making M indifferent between the two suppliers and M's marketplace margin from recommending S_2 cannot exceed $v - c_2$. Therefore, M's marketplace margin from recommending S_1 is also constrained by $v - c_2$.

Notice that M may charge S_1 a transaction fee that is higher than $v - c_1$, which means that S_1 could make negative profit by selling through M's marketplace. However, S_1 may accept such a transaction fee and set $p_{m1} = v$ to obtain M's recommendation because S_1 makes positive profit in the direct channel. M's optimal transaction fee to S_1 is not unique because regardless of the transaction fee, S_1 will set its direct price to make sure M makes a profit of $v - c_2$ by recommending S_1 to one consumer. Thus, M is indifferent between any transaction fee that yields non-negative retail profit for S_1. In particular, we denote by $\bar{f}_1$ the fee that yields exactly zero retail profit for S_1, which maximizes M's profit. That is,

$$\begin{aligned}
\psi(\bar{f}_1) &= (v - c_1 - \bar{f}_1)(1 - l(\widetilde{p}_{d1}(\bar{f}_1))) + (\widetilde{p}_{d1}(\bar{f}_1) - c_1) l(\widetilde{p}_{d1}(\bar{f}_1)) \\
&= c_2 - c_1 - \left(1 - \frac{v - c_2}{\bar{f}_1}\right)^2 \mu_1 \\
&= 0.
\end{aligned} \tag{58}$$

Solving this equation yields

$$\bar{f}_1 = \frac{v - c_2}{1 - \sqrt{\frac{c_2 - c_1}{\mu_1}}}.$$

Notice that M's profit is decreasing in w_1 and w_1^* is decreasing in f_1. Thus, in the equilibrium that maximizes M's profit, M charges $f_1 = \bar{f}_1$. Then, we substitute $f_1 = \bar{f}_1$ into equations (56) and (57), solving the equilibrium wholesale price and procurement quantity

$$\begin{aligned}
w_1^* &= \frac{c_1 + c_2}{2}, \\
q_{m1}^*(w_1^*) &= \frac{(c_2 - c_1)\bar{q}}{2c_2}.
\end{aligned}$$

Although the equilibrium transaction fee to S_1 is a function of consumers' leakage propensity ($\frac{1}{\mu_1}$), the equilibrium wholesale price and procurement quantity only depend on suppliers' marginal costs.

B Source Notes for Table 2

[a] Amazon.com, Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2025, filed Feb. 6, 2026 (SEC accession no. 0001018724-26-000004). FY2025 net sales include "Online stores" (first-party, recorded gross) of $269B and "Third-party seller services" (recorded net) of $172B, of $716.9B total; Amazon reports third-party sellers as 61% of paid units (first-party 39%).

[b] Coupang, Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2025, filed Feb. 2026 (SEC accession no. 0001834584-26-000024). FY2025 Product Commerce segment net revenues $29.6B of $34.5B total (86%), predominantly owned-inventory retail; the revenue note distinguishes "net retail sales" (owned inventory, gross/principal) from "net other revenue" (third-party merchant services, advertising, fulfillment fees, net/agent).

[c] JD.com, Inc., Annual Report (Form 20-F) for FY ended Dec. 31, 2025, filed Apr. 16, 2026 (SEC accession no. 0001193125-26-157870). FY2025 total net revenues RMB1,309.1B (US$187.2B); "net product revenues" (first-party direct sales) are the large majority (80% in FY2024), with "net service revenues" (marketplace, logistics, advertising) the remainder.

[d] Walmart Inc., Annual Report (Form 10-K) for FY ended Jan. 31, 2026, filed Mar. 13, 2026 (SEC accession no. 0000104169-26-000055). The filing states some products are sold by third parties in marketplace transactions and describes marketplace fulfillment/inventory arrangements, but does not disclose the first-party/third-party share of sales.

[e] DoorDash, Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2025, filed Feb. 18, 2026 (SEC accession no. 0001792789-26-000013).

[f] Zillow Group, Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2025, filed Feb. 2026 (SEC accession no. 0001617640-26-000015).

[g] Airbnb, Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2025, filed Feb. 2026 (SEC accession no. 0001559720-26-000004).

[h] Rover Group, Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2022, filed Mar. 9, 2023 (SEC accession no. 0001826018-23-000015). Risk factor: "Off-platform bookings and payments have had and may continue to have a material adverse effect on our business."

[i] Upwork Inc., Annual Report (Form 10-K) for FY ended Dec. 31, 2025, filed Feb. 12, 2026 (SEC accession no. 0001627475-26-000012).

[j] Airbnb, "Off-Platform Policy" (Airbnb Help Center) and Terms of Service, which prohibit users from soliciting or facilitating any off-Airbnb transaction (e.g., redirecting communication or payments off-platform); enforcement was tightened effective 2025.

[k] Rover, Terms of Service and Help Center: "Initiating a booking through Rover and then completing the transaction off Rover violates our Terms of Service" and may result in account deactivation; booking and payment through Rover are required. https://www.rover.com/bookings-on-rover/

[l] Upwork, User Agreement §7 (Non-Circumvention) and Help Center: payments for Upwork relationships must remain on-platform; circumvention is a material breach that can result in account closure. https://support.upwork.com/hc/en-us/articles/360052511133-Circumvention-and-why-it-s-against-the-rules

[m] Amazon, "Selling Policies and Seller Code of Conduct" and "Prohibited Seller Activities and Actions Policy" (Amazon Seller Central): sellers may not attempt to circumvent the Amazon sales process or divert Amazon customers to another website, including by placing hyperlinks or URLs in messages or listing fields that direct customers off Amazon. Governs the third-party (marketplace) side. https://sellercentral.amazon.in/help/hub/reference/external/G200386250

[n] Coupang, "Seller Code of Conduct" (Coupang Global Marketplace): prohibits sellers from attempting to circumvent the Coupang sales process or divert Coupang customers to another website, including by providing links or messages directing users to an external site. https://globalsellers.coupang.com/en/rules-and-policies/seller-code-of-conduct/

[o] Walmart, "Marketplace Seller Code of Conduct" and "Seller Suspension and Termination Principles" (Walmart Marketplace Learn): sellers must not divert customers or transactions from Walmart to another website, including via hyperlinks or URLs in listing content, description fields, or seller email messages. https://marketplacelearn.walmart.com/ca/guides/Policies%20&%20standards/Account/seller-suspension-and-termination-principles#Actions%20that%20Divert%20Walmart.ca%20Customers%20or%20Transactions

[p] JD.com, JD Open Platform merchant rules (https://learn-jdm.jd.com/knowledge/rule/detail?ruleId=923540006109319168; rule 21 published in Chinese), which prohibit merchants from directing transactions off-platform/offline and other conduct that violates the normal transaction process, with penalties up to store removal.